ADOPTING MOOCS FOR QUALITY ENGINEERING EDUCATION IN INDIA

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Abstract

In India, over 5,000 engineering colleges affiliated to different universities, offer conventional engineering education. Teachers in colleges do the teaching, but universities rigidly control the program of study, syllabus, and examinations. The quality of education, is a matter of concern. MOOCs (Massive Open Online Courses) permit learners to access and benefit from the teaching by renowned professors. MOOCs offer an unprecedented opportunity to revitalize education. These cause complete dis-intermediation of the university system, making them very affordable; however, they have several shortcomings in their present form. Students enrolling for a MOOC still have to conventionally study the subject for their degree. Complete absence of physical group activities in a class room under a teacher's mentoring, is another serious issue. Conduct of practical sessions in laboratories is an important aspect of engineering education, for which MOOCs offer no alternative.

We propose a blended MOOCs model for adoption in India. It envisages acceptance of MOOC grades by a university towards its degrees. It also stipulates an important role for local teachers, who will use a 'flipped class-room' model of teaching. They will conduct group discussions and problem solving sessions rather than mere lecturing; and locally give and evaluate assignments of which the marks will be factored in the final grade. They will also conduct laboratories where needed. They will thus mentor and guide students, under their charge.

Key words: MOOCs, Blended-education, Flipped-classroom, Group-activity, Teacher-centric, Laboratories.

1 GROWTH OF ENGINEERING EDUCATION IN INDIA

India has about 5,000 engineering colleges today, a 25 times increase from just about 200 colleges 30 years ago. Annual enrolment of students in these colleges, is now over 1,250,000. The number of qualified and experienced teachers, is highly inadequate. As India moves to increase the GER (Gross Enrolment Ratio) in coming years, the need for quality teachers will increase, and the supply-demand gap will widen.

Quality of engineering education in Indian colleges, suffers primarily because of the rigidity of our University system. A number of engineering colleges are affiliated to a University. While teaching takes place in individual colleges; it is the University which controls the syllabus, and also the examinations. Teachers are required to teach strictly as per the prescribed syllabus which changes at a snail's pace, if at all. There is a fixed plan for the examinations. The papers include standard options such as 'Answer any 6 out of 10 questions'. The questions themselves are mostly descriptive, such as 'explain something', or 'describe something briefly', or 'write short notes on any two of the following', etc. Such papers are rather sweetly called 'theory' papers. Problem solving abilities, central to engineering education, do not get adequately tested at all. As an added attraction, the questions are often repeated across examinations conducted in different years. A teacher, who teaches, has no control or even a say in these matters. Someone else is going to set the question paper, and some other one is going to evaluate the answer books. It is not uncommon to find that students routinely bunk classes, and attend coaching classes or read guide books, which provide specialized training in passing such 'standard' examinations.

I myself studied in a similar college in the city of Indore. It was and is a good college, known for its quality faculty and students, but with a similar make-up. My own experience was that I studied 100% syllabus in the first year. Having discovered the 'choice' in all examinations, I studied only 60% syllabus in the second year, still securing more than 80% marks. In the third year, I enhanced my skills to predict with reasonable accuracy, as to which questions were likely to be 'repeated' from the papers of previous years, in the next examination. I could further optimize on study-time. Smarter students resorted to guide books and coaching classes, with more optimal outcomes.

For me, things changed drastically when I joined IIT Bombay for my M Tech in 1969. My first brush with the IIT style examination was Prof. Jimmy Isaac's 'open book' test. Time specified was 2 pm 'onwards'! Delighted, I carried six books to the exam. I was shocked to see no descriptive questions and no choice at all. There was simply a set of problems to be solved. Jimmy's style of conducting the examination was also very funny. He kept walking around the class, reading the solutions being worked out by students, occasionally slapping a student on the back, shouting 'not this way idiot, read that chapter from that book, and solve again'. I recall receiving two slaps. I returned the answer book at 6 pm. I was not the last student out, as there was one more joker still struggling. I was completely frustrated, but upon reflection later, I realized that I learned more in those 4 hours, than I did in a semester back home in my college.

A teacher in the IIT system has absolute control of the subject he or she teaches. Why is it that one Jimmy Isaac succeeds in motivating us to learn better, whereas like-minded teachers elsewhere, are not able to do so as effectively? Why is it that the university system has not changed significantly, whereas the IIT system has thrived on continuous experimentation with the process of teaching, learning, and testing?

A large number of very good engineers come out of our engineering colleges. There are several excellent teachers in many colleges. Yet, the IITs somehow manage to produce better trained engineers. While it is true that funding available to most engineering colleges is meagre as compared to IITs, I believe that the true differentiator is the immense autonomy and its responsible and creative use, which one teacher enjoys; and other does not.

2 ROLE OF A TEACHER

To learn, to gather knowledge, and to use that knowledge for making life more comfortable, prosperous, and enjoyable, are now integral parts of human endeavours. The society recognized very early that the vast amount of knowledge, gathered and accumulated over generations, must be passed to the next generation, for it to be substantially assimilated at an early age by the young humans. It is this urge to educate the young of the species quickly, which prompted humanity to create the Institution of a 'teacher', charged with the responsibility of codifying, storing, disseminating, and enhancing knowledge. No other species (barring perhaps the bird Jonathan Livingston Seagull described by Richard Bach!) has created such an institution. In order to support this institution of a teacher, structures were created, which were known in India as Aashram or Gurukul in old times. Temples, Mosques, and Churches often served as places for teachers and disciples to congregate. A teacher in those days had the same stature as that of a parent. In fact, the ancient Indian tradition required a student to leave the safe abode of parents at the age of 6 or 8 years, and live at teacher's home for next 12 years to learn from the Guru. Apart from disseminating knowledge, the teacher was also responsible to inculcate values and discipline in the minds of the young. Under the mentorship of a teacher, a student would mature from a young learner into an informed and wise adult, ready to live in, and contribute to, a healthy, prosperous, and happy society.

Over the centuries, these support structures got formalized into schools, colleges, and universities. Curiously, these are now called institutions, and the original 'institution' of the teacher, has now assumed the status of a paid employee of these institutions. The stature of a teacher, with the attendant autonomy, is still maintained in some places, such as most of the well-known universities, including our IIT system, and in some renowned colleges. However, in the affiliated colleges and their universities in India, the education process, particularly the engineering education, is governed by hierarchy, procedures, rules, committees, rigid syllabi, a set pattern of examination, and the like. Most teachers have lost the freedom to interact with students as they wish, to decide on the way topics of a subject ought to be discussed, and to conduct the evaluation process as they deem fit.

When a teacher endowed with autonomy, teaches in a college or university, as I teach at IIT Bombay, things are different. There is a defined syllabus, which gets updated even as teaching progresses in a semester. What I cover is the operative syllabus, what I set is the examination style, and the grade I give is the final grade accepted by the Senate of the Institute. In the IIT system, two teachers teaching the same subject in different years, often teach it completely differently from each other, even emphasizing different topics in their offerings. This is accepted and respected, because students still learn the essentials as these are always covered by both the teachers. More importantly, students understand that engineering problems are neither 'simple' nor 'standard'. It is such autonomy that permits a teacher to challenge the students' minds, to make them think and learn, and to make them better prepared to face the real world.

A teacher from an affiliated college, on the other hand, is forced to behave like an employee, doing only what the 'system' stipulates. This teacher has been led to believe that the only 'job' to be done, is to deliver assigned lectures strictly as per stipulated syllabus, conveniently broken into very well-defined modules; to supervise examinations, and to evaluate answer-books (of some other students) in a stereotype fashion. The task of imbuing discipline of thoughts, academic rigor, and ability to attempt solving hard problems, is not his or her any more. Inculcating values about life in the minds of students, and mentoring them to become

contributing citizens of the society, may remain farthest from the thoughts of such teachers. I have interacted with a large number of exceptionally good teachers in such a setup of affiliated colleges. They all feel deeply stifled, and tell me that their attempts to discuss real-life problem solving in the class, are often rebuffed by students as being 'out of syllabus'.

Several educational leaders in the country have observed that the general quality and preparedness of teachers in most autonomous institutes including IITs, and in several university departments, together with their research orientation, make it possible for them to exercise such autonomy effectively. It is said that the teachers from most affiliated colleges, do not always possess such qualifications, experience, and research orientation, and therefore only a rigidly defined system is able to get the best contribution from them, in our educational process. While there is some truth in these observations, making a local teacher just a cog in the wheel, seriously undermines his or her ability to positively influence the learner's mind. Besides, is not every teacher, even in such rigid setting, desirous of improving oneself, wanting to try solving harder problems, and wishing to participate in meaningful research work? Has the system ever given them sufficient time and training in these aspects?

I believe that there is a way out to ensure a central role to our teachers, while ensuring compliance with global educational standards. This is possible because the technology available today, permits us to free the teachers from the mundane tasks assigned hitherto, and to resurrect their central position as a guide and mentor to the students under their charge.

3 ONSLAUGHT OF MOOCS

It has long been predicted that the next disruptive changes due to web, will occur in education and health care. Research interest in e-learning paradigms is actually quite old. Personalized tutoring systems have been under development for decades. Open source educational content of high quality, is now available in searchable digital formats. A knowledge seeker today has unprecedented access to quality content.

3.1 Working of present MOOCs

The operations of any MOOC offering resembles the sequence of activities followed in a conventional teaching of that subject. A MOOC is announced by some well known professor of an Institute, through one of the companies offering MOOCs. The announcement includes the broad course content, prerequisites if any, the course start date and duration. Learners from all over the world register on-line, without having to satisfy any eligibility criterion. This is what makes the course 'open' and accessible to any learner. From the start date, the course lectures can be accessed on the website. These are video recorded lectures. Activities such as practice problems and trial quizzes are embedded in these recorded lectures. Usually, a weekly schedule is prescribed. During each week, the participants listen to the lectures, solve practice problems, and give trial quizzes. The participants are required to appear for on-line tests every week or fortnight. The test questions are either multiple-choice or short answer type, and are automatically graded. Scores for these weekly or fortnightly tests are accumulated, and are factored into the final grade. There could be additional on-line examinations, similar to our conventional mid-semester and end-semester examinations, again graded automatically, and counted towards final scores. Some courses require assignments (long answers) to be submitted on-line. Evaluation of such assignments is often done through a peer evaluation process. Automatic grading of such long answers, is not yet possible. It is being attempted through specially designed machine-learning algorithms, currently under research and development.

A suitable IT infrastructure is put in place to run MOOCs. This comprises of a cluster of servers running a sophisticated server application. This cluster is connected to internet with a fairly large bandwidth so as to support millions of online users across the world. The software permits creation of all the learning material including lecture videos, handouts, and question banks for quiz and test examinations. It provides online registration and access control to course components through an extensive LMS (Learning Management System). There are server modules to permit participants to upload their assignments, and conduct online examinations. A good discussion forum is provided for participants to pose questions and difficulties, and to receive explanations and clarifications from the professor as also from other participants. Last but not the least, there are modules to capture and store actual use of the system by participants. Since all interaction is on-line, the back-end software is able to capture the entire activity by each participant.

When and how long a participant watched a lecture, is known; when did a participant attempt a quiz is recorded; which answers were given against each question is also recorded. A MOOC offering is thus able collect huge data on the academic behavior of the participant throughout the duration of the course. This data is almost a gold mine, and feeds into extensive research happening in the areas of pedagogy. The feedback is used to make subsequent offerings better.

The online examinations and quizzes are ordinarily not supervised. Most offerings instead have an 'honor code' which participants agree to. Basically, the code stipulates that a participant will attempt all examinations on one's own efforts. A certificate is issued to all participants who complete the course successfully, based on this honor code. Some courses also offer an 'audit option', which does not require participants to pass examinations. Some of the MOOCs offerings are adopted by conventional universities, where the course material is from the MOOC content, but the university conducts its own examinations.

The revenue model in such offerings is very interesting. Initially, all companies offered these MOOCs free of charge. Once the credibility is established in the minds of participants, there are now attempts to charge for certification. The charges currently vary between $50 and $100 for each course. Since the examinations are not supervised, there is a limited value perceived by participants, and the number opting for such paid certificates is rather low as of now. Some offerings give a 'validated identity' certificate. What is done is that the identity of a person is initially recorded based on an appropriate identity proof. In all interaction during the course, the participant is required to use a web-cam through which it is ensured that the same person is doing all the work. Additional checks, such as a 'typing profile' test, are done for such interaction. In any case, the certificates so issued seem to have a limited value proposition as of date, and does not compare with the value that a participant associates with a regular grade from an established university. Employers and universities also do not consider these to be equivalent to a regular course.

3.2 Limitations of the MOOCs

Online courses and makers of e-learning artefacts, sometimes seem to imply that an individual student can complete all studies in self-learning mode. There is no evidence yet to suggest so. However, use of technology for providing quality education on a truly massive scale, is quickly coming of age as seen in the last two years. MOOCs are rapidly gaining popularity. Some notable efforts by Coursera, edX, and Udacity, are well documented. A Wikipedia

article [1] provides a balanced view of pros and cons of MOOCs. IIT Bombay has already announced offering of MOOCs in select subjects from 2014, in collaboration with edX [2].

I am personally not convinced that the MOOC offerings in the present form alone will succeed in reshaping the existing Indian higher education system. My opinion is based on some prominent concerns. The first is that, in the MOOCs offered so far, the completion rate has been very low. A survey published by Katy Brown [3] indicates that in the online courses with registration of over 100,000 participants, the completion rate has only been between 3% and 13%. I have tried to analyse possible reasons for such huge dropout, from the perspective of an Indian student who is already enrolled in a University, and is studying in an affiliated college. The second concern is the serious disruption which the present MOOCs cause in the human interaction prevalent in the present system. I am particularly worried about the complete removal of any role for a teacher in a college, which to me is a disastrous consequence of the disintermediation of the entire University system, which MOOCs bring about in their present form. Another important concern is the lack of exposure to practical sessions conducted in engineering laboratories for the students, as a part of regular curriculum. I present my arguments on these concerns in the next subsections.

3.2.1 Dilemma faced by students enrolled for a university degree

This analysis is based on the different styles of education in the two systems of Indian Engineering education - in the general university system ('A'), covering over 4,800 engineering colleges in India, as against what takes place in IITs, NITs, and similar well known institutes, and in several university departments (‘B’).

Consider a student of 'A', studying a certain subject as a part of the university curriculum. The student is required to appear for and pass the examinations conducted by the university. The marks and grades obtained therein are counted towards the degree which the student eventually earns. These are vitally important for the student, since all employers look at these carefully before offering a job, or before even calling someone for a job interview. Assume that the same subject is now available as a MOOC. The student may register for the MOOC offering, hoping to learn the subject better, because some renowned professor from a well-known institution 'B' is offering it.

After some initial online interaction with this MOOC, the student may find that the level of questions in the tests or assignments, is far more difficult than the ones found in his or her college and university examinations. At the least, these will be significantly different from the familiar style of examination papers. As mentioned earlier, the standard university papers require long answers which can be reproduced from memory. Such questions are rarely if at all, asked in question papers of 'B'. The 'A' paper will typically announce upfront, a choice such as 'Answer any five questions'. There is no such choice in papers from ‘B’. Many teachers in 'B' offer open-book examination, a practice simply non-existent in 'A', but will be used with a MOOC.

The student must prepare for own university examinations in any case. If the learning from the MOOC does not directly enable the student to prepare better for the standard university examinations, then the efforts on MOOC may appear to be a waste of time, and a guide book will perhaps be a far better choice for the student!

3.2.2 Disintermediation of human interaction

Consider the difference in the engagement with students in these two models. In the conventional system, students interact daily with teacher and with each other on numerous occasions. Such group activity is a vital component of education. The learning that happens during such group interaction, actually goes much beyond just the academic learning. Importance of team work and leadership, is better understood by students through group activities. Lifelong friendships are formed during these interactions, resulting in a strong human network which often proves very useful in future professional life. Participation in games and sports, cultural activities and debating competitions, and technical festivals, contributes to the total education which one receives during the college days. Indeed, there is much more to education than just the excellence in understanding and mastering the technical subjects; but, for the present discussion, let us limit our analysis to just the academic learning.

In a classroom environment, one does not learn by listening to lectures alone, but has a chance to seek explanation from the teacher, or from fellow students. The interaction is largely verbal, sometimes even in one's native language. Such help is more comforting and acceptable than the discussion offered by a MOOC, where both question and answer need to be typed in a discussion forum, and only in English. Group assignments and projects, where a team of students work together for several weeks to solve a rather complex problem, are considered an important learning component and is routinely practised not just in IITs and NITs, but also in many colleges where some internal evaluation is permitted by the affiliating university. Most teachers additionally provide handholding support to weaker students in a class, through individual or group discussions.

All these academic interactions are facilitated by the teacher teaching that subject in the college. The importance and usefulness of organizing and facilitating such group interactions is critical to education, independent of how good or bad the ‘lecturing’ is. A conventional MOOC has no place for any of these.

3.2.3 Practical Laboratory Sessions

Every engineering curriculum emphasises inclusion of practical sessions in laboratories. Students get to work on actual equipment and instruments, learn to make measurements of all concerned operational parameters through observations and readings in well defined experimental setups, and understand how things work in practice. These hands-on sessions in laboratories, form a crucial component of engineering education the world over. This is where students dirty their hands, and learn all the real world aspects of engineering.

In the current MOOC offerings, Such practical sessions are impossible to arrange in any online environment. I have seen some online courses where video recorded ’experiments‘ are included as part of recorded lectures. There are also many e-learning tools, which try to explain such experiments using animations, simulations, and video clips. All these at best complement, but do not substitute, hands-on experience. Literature on MOOCs is indeed silent on this aspect, almost to the extent of having a blind spot in this regard.

I believe that practical understanding of real instruments, gadgets, and equipment, forms an important component of engineering education. The infrastructure needed to learn these things, exists only in established colleges, and in engineering industry. It is also important to remember that practical sessions are group activities, again organized and supervised by a teacher in a college. Without these, learnings from MOOCs will not provide complete understanding of ‘engineering’.

4 A BLENDED MODEL FOR ADOPTING MOOCS IN INDIA

IIT Bombay, in a unique experiment, proposes to introduce a blended model which will address the limitations of MOOCs in their present form.

4.1 Acceptance by Universities

First and foremost, it is necessary to resolve the dilemma faced by a student of an affiliated college, mentioned earlier. Should time be spent in learning from a MOOC, or is it better to stick to tricks, in passing university examinations with good grades? We propose that a university should accept the grade obtained by the student in a MOOC, to be the grade for an equivalent university course. This addresses the problem of duplicate efforts. In fact, the student will not have a choice, since the university will declare the course to be taught as MOOC only. This has been attempted in US through a notion termed SPOC, but our model has uniform applicability to a large number of universities and affiliated colleges which teach courses with a near similar syllabus, defined on the lines of a model syllabus approved by AICTE (All India Council for Technical Education). The fact that teaching system and examination patterns are similar across most of our 5,000 engineering colleges affiliated to over 300 universities, will help us achieve this scale. Incidentally, the chairman of AICTE, Dr. Mantha, announced last year, that AICTE may permit up to 15% of the credits of a degree to be obtained through MOOCs. Another committee appointed by UGC, is currently addressing the issues related to MOOC offering in Indian higher education system.

One major issue in the MOOCs is that the simple 'honour grade' given by a MOOC, will not be acceptable. So the on-line examination will have to be supervised, and so certified. This is already being done in some global offerings. In our model, we suggest that the teacher in the college, be made responsible for such proctored online examination.

4.2 Human Interaction

The second component of our suggested approach is more important. It attempts to transform the local teacher into a true mentor and guide to students. In our model, regular classroom engagement in the college still continues, but instead of lectures, the teacher will hold discussion and problem solving sessions, as in the 'flipped classroom'. A teacher will now be able to spend much more time with the students in these discussion sessions, helping weak students through more elaborate explanations, and challenging the better performing students with harder problems. In fact, teaching will be personalized to a much greater extent. Additionally, we propose that the local teacher should give individual assignments and offer course projects to be done by small teams of students. The project activity will typically be in the second half of a semester long course, spanning 4 to 6 weeks. Each project will be offered, evaluated, and graded by the teacher; and not by the college or university administration. The score for each student in the assignments and group project, will be directly factored into the final grade awarded by the MOOC. The weightage of the MOOC online score to the teacher's score is proposed to be 80:20, or 85:15. This makes the local teacher an important stake-holder in the entire process. More importantly, by restoring the autonomy of the teacher in this fashion, I believe that the stature of the local college teacher will be resurrected, and will be brought closer to the one originally intended for teachers.

Some senior leaders of our education system have pointed out that there may be resistance from teachers who are used only to their current style of functioning, who may genuinely be

concerned about their preparedness in assuming this new role. They will now have to face questions and difficulties posed by the students all the time. They will have to solve more difficult and complex problems. They have to innovate in assigning and guiding course projects. They now have to take responsibility of marks they award to each student out of the 15 or 20% of the total marks. Well, with autonomy, comes such responsibility!

The only way to reduce and remove this reluctance, is to train these teachers extensively in their new and more important role. For those Indian universities which accept our MOOC grades, we propose to train teachers of all affiliated colleges in this approach. We know we can, because such training on large scale is precisely what we do well, through the T10KT (Train 10 Thousand(K) Teachers at a time) program, being conducted by IIT Bombay [4] and IIT Kharagpur [5], under NMEICT (National Mission on Education using ICT). In fact, encouraged by our project review committee chaired by Prof. Nigavekar, ex-chairman of our University Grants Commission, we propose to conduct our T10KT workshops themselves through a blended MOOC - a real bootstrapping approach.

4.3 Practical Sessions

Laboratories are used to conduct practical sessions for students, and form a critical component of engineering education. Such practical sessions constitute a mandatory part of several courses for an engineering degree. While the present MOOCs cannot handle this aspect at all, our blended model will be able to resolve this issue. The local teacher in-charge of the course, will also supervise and conduct these sessions. Indeed, when designed in conjunction with a common MOOC syllabus, some uniformity in quality of practical sessions across the colleges and university can be achieved.

5 Blended MOOCs from IIT Bombay

The proposed blended MOOCs model is based on the experience gained in experiments done by some of us in running a flipped classroom at IIT Bombay. In the blended model, students study available digital material on their own, including viewing of pre-recorded lectures. They then attend classroom tutorials and discussion sessions, and practise solving problems in groups, under the supervision of a teacher. This ‘flipped’ classroom model has been tried in IIT Bombay and at some other sister institutions. It was found initially that the students do not always listen to pre-recorded lectures on their own as advised, and are often unprepared for classroom discussions and problem-solving sessions. This was addressed by conducting quizzes in every class. My colleague Prof. Kannan Moudgalya has nearly perfected this approach. In the picture (figure 1), he is using the clicker application on Aakash tablets[6] to conduct a quiz.

Fig.1: Conduct of Clicker based quiz using Aakash tablets

A senior alumnus of the Institute, Ruyintan Mehta, attended one such class during his visit to IIT Bomaby. He was convinced that this approach will definitely make students more attentive. His reasoning is very simple – students are always more alert when giving examination of any kind, when marks are involved! Another colleague, Prof. Kameswari Chebrolu, has successfully conducted her course on Computer networks using the flipped classroom. She reports that students want video recorded lectures of shorter length.

When IIT Bombay decided in early 2012, to start offering MOOCs, a committee deliberated at considerable length for choosing a suitable partner from amongst the well-known alternatives, and decided upon edX. Our decision to partner with edX was influenced by several factors. One is that edX is a non-profit organization, initially funded by contributions from MIT and Harvard. There is nothing wrong with for-profit companies, but our comfort level is greater otherwise. Another is MIT's Open Course Ware history. This is in consonance with our own desire at IIT Bombay, to open-source as much knowledge content as possible. Last but not the least, is their decision to open source the edX platform itself, for future collaborative development. This was critical because we had started planning to offer the blended MOOCs to Indian students, and a proven platform which could be modified and deployed for Indian usage, will significantly reduce development efforts and time.

We have decided to offer four of our courses in the next academic year, through edX. We plan to try at least one course for adoption of this blended model by multiple universities. I have held preliminary discussions with several academic leaders of Indian universities and engineering colleges, and the initial response has been very encouraging. We will probably offer such a course initially only to a limited number of students of select colleges and universities, restricting it to, say about 200,000 students with involvement of about 5,000 to 8,000 teachers. We will expand after fine tuning our approach from the experience. In future, it should be possible to engage all of 1,125,000 Indian students being admitted to first year of engineering degree, for example, in some core course offered as a MOOC. It is my dream that such scale in quality education is achieved within the next two years.

There are a large number of additional issues which need careful application of mind, and fool proof solutions. I will just mention one of the technical issues in information management, which we will face: the LMS (Learning Management system) will have to permit representation of groups of students hierarchically arranged. One must be able to identify a student as belonging to the specific administrative node in this hierarchy, and maintain all records of interaction with local teacher, scheduled submissions made locally, marks awarded by the local teacher, etc. MIS reports will have to be generated appropriately and separately for a batch of students and the associated teacher, for students of a department in a college, for the college as a single group, and for the entire university. Apart from a GUI for data entry, file uploads by local teachers will have to be permitted. It is not a difficult problem, but one which must be addressed by appropriate modification to the platform used.

There are other practical problems in implementing such blended solutions across India, where a stable and continuous availability of high capacity internet bandwidth to engineering colleges, may be difficult to guarantee. We propose to build a distributed implementation, with a local server in each college, so that the students can continue to work in a LAN environment in case of internet outage. IIT Bombay proposes to use a suitably modified edX platform, to initiate our blended MOOCs offering.

6 CONCLUSION

In any mass scale adoption of technology for education, the teaching-learning process must be carefully defined and tuned. Issues of examinations, evaluation, and certification need to be addressed. The value proposition that such technology enabled education offers, must be examined from the point of view of all stakeholders – students, teachers, institutions, and employers. The transition in our education towards greater use of technology, may take several years. Technology Enabled Learning will continue to mature and evolve, but one thing is certain: enhancing quality of education on such a large scale, as needed in India and in several developing countries, cannot be achieved without extensive and appropriate use of technology, adopted with ingenuity and focus.

We have analysed the present MOOCs in this context, and have proposed a blended model for engineering education in India. Our vision is to explore, examine, and solve pedagogical and technical issues, and establish the best possible model of blended learning, for Indian education system. We sincerely hope that a successful implementation of this model will lead to its adoption in other spheres of higher education, with possible eventual use in our School education as well.

7 Acknowledgement

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