Conventional Education & Online Education in Engineering: A Case Study

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Abstract. Online education is gaining ground since last few decades all over the world including India. But so far it is utilised mainly in various alternative courses or knowledge-enhancing courses beyond regular curriculum which learners could opt as per their convenience and interest using internet access, particularly if the situations in Indian universities are considered. But under COVID-19 pandemic situation, the utility and use of online education is suddenly multiplied and extended and is made inclusive within regular university semester courses also. Undergraduate engineering is one of the very prominent areas to mention. Accordingly, in the present study, the authors tried to show that in the last even semester, how the online education served the basic subjective needs of engineering students so far as their learning is concerned. For that purpose, a students' feedback data based on the online teaching provided is analysed in detail, which are taken from one of the standard engineering colleges of West Bengal. Corresponding results are analysed for end semester examination conducted online and is compared finally with relevant data obtained from evaluation of conventional education for some interesting discussion.

Keywords: online, conventional, education, COVID-19, pandemic, undergraduate

Introduction

Today’s “online” learning was started almost thirty years back in the 1990s with the advent of the Internet and World Wide Web (www) facilities and reached to individuals who tried to eliminate travel time and also to remote locations. Such electronic education (e-education) facilitates asynchronous as well as synchronous delivery methods which extends access to online video conferencing, chat rooms, and also to discussion boards.[1].

The diverse history of online education is found to evolve in several phases using Internet-propelled distance education in 1990s, Learning Management Systems (LMS) during 2000–2007, through Growth of Massive Open Online Courses (MOOCs during 2008–2012, and beyond [1], where increase of online higher education enrolment played a major role. In this context it may be mentioned that the National Programme on Technology Enhanced Learning (NPTEL), the Ministry of Human Resource and Development’s (MHRD) project, was formed in 2003 by active initiation of seven Indian Institutes of Technology (IIT) and the Indian Institute of Science (IISc), for providing online education in India formally. The main purpose was to introduce relevant web and video courses in main streams of science, engineering, and management [2], not only for students but also for the teachers to improve teaching-learning system.

But the growth of NPTEL upto 2010 was only decent, then started taking pace mostly because of introductions of various online programs by the universities in their curriculum to avail improved, updated and easily accessible contents using advanced technology. Still those courses were popular among limited learners, mostly were advanced in academics and equipped digitally or few part-time students who joined these courses because of various compulsions. Introduction of the concept of Career Advancement Scheme (CAS) for the teachers and different mandatory online credit courses in AICTE curriculum for the students in recent past tried to break down the inhibitions of major group of learners towards such online education with some success. But the present Covid-19 pandemic has pushed universities & institutions along with their teachers and students across India, along with the
entire world to shift to online classes suspending physical classrooms [2]. Actually in this crisis period utilisation of online education is the best option to explore Digital India Movement and is so adapted automatically.

This transition is smoothly done in most of the private educational institutes, but the situation is found to be different in government and semi-government educational sectors [2] where the nature of classes, the probability of online examination conduction and the system of evaluation, is still a debatable issue. Higher education is not only limited to examinations, classes, or grades only, but it makes a holistic development of students so that they become active members of a nation’s work force and can cope up with every situation having requisite skills, knowledge, and life experiences [3]. So students learning should not be limited to online classes only without figuring out to gauge the gained knowledge. Otherwise their career might be impacted so far as their future prospect is concerned, when university may not take the responsibility.

The present work is so based on the stepwise analysis of successful implementation of online education during last semester for one private institute, as an example. It has addressed all possible components of an academic system starting with teaching-learning, including both conventional as well as online mode, students’ feedback on its merits and demerits, followed by online examination and assessment of teaching-learning status for final semester, during COVID-19 pandemic.

2. Material & Methods

As already mentioned, authors have chosen here one self-financed, autonomous AICTE approved & Maulana Abul Kalam Azad University of Technology (MAKUT) affiliated and well-established Engineering College in Kolkata, West Bengal to study and analyse their last even semester 2020 academic activities.

2.1 Study System

The college under consideration started its academic activities with conventional mode in January, but ultimately shifted to online digital platform from 3rd week of March for all students. As per the guideline of published notification by University Grant Commission (UGC) during COVID-19 outbreak, the college conducted the online examination using its available infrastructure in proctored mode and completed the evaluation of 8th semester examination in 3rd week of July successfully for the students whose recruitment in various technical organizations were subjected to the award of their graduation degree (B.Tech.). The aim of the present study and analysis for this huge endeavour of the college is to have the primary signature of the transformed system on academics, if any. Here it may be mentioned that along with midsemester unit tests, all other even semesters’ online assessments (under autonomy) were also done in the institute.

2.2 Methodology

The present analysis is conducted in three steps.

2.2.1

To study and analyse online academics as a first step, authors have collected & analysed data for total number of classes conducted and unit tests taken, both online and in conventional mode, from conducted class records of students from first year to fourth year for a specific stream, as a sample.

2.2.2

As second step, authors collected the feedback taken online in a structured format from the students of the stream under consideration and it is analysed. Number of Parents-Teacher Meeting (PTM) conducted, is also recorded.

2.2.3
As third step, detailed result analysis is done for four streams of 8th semester students including the particular stream considered for previous stages also. Here along with this result where semester examination was conducted online, two previous semesters’ results of the same batch of students, where examinations taken in conventional mode are compared. That is quite logical to have a check on the overall trend. Finally, previous batch students’ 8th semester’s result (examination taken in conventional system) data is compared with present batch online data to have the idea of deviation in results when examination was shifted from subjective tests (conventional) to objective tests (online).

3. Results and Discussions

Last even semester academic activities started in January 2020 with regular physical classes. But rapid worldwide spreading of COVID-19 prompted the World Health Organization (WHO) to declare it as ‘pandemic’ on 11 March 2020. Accordingly, most of the governments around the world including India took several steps to curb the spreading of this highly contagious disease by imposing lockdown, social/physical distancing, avoiding face-to-face teaching-learning, and implementing restrictions on immigration [4].

So from 18th March onward, the Engineering College authority under study, implemented sudden transition to online classes where faculty members started delivering their allocated courses live with new ways of teaching using various available online platforms like Cisco WebEx, Zoom, Go to Meeting, Google Classroom, WhatsApp, E-mailing and sometimes even Skype. Most of the students were found to respond immediately by joining these online classes through corresponding links provided by the concerned course coordinators, with exception of few who couldn’t arrange proper network connectivity mostly because of their remote locations from the nearby city or town. So the concerned teachers supplemented their classes by sharing study materials in various forms including video and audio files through the internet. It was reported that though started suddenly in no time after lockdown imposition, online system started performing steadily with the immediate introduction of dedicated server for the institute by the reputed online service provider Myperfectice Whiteboard in their platform, Other digital platforms were parallelly used to support other relevant programs and activities related to academics.

3.1 Teaching-Learning in the even semester 2020

Table 1 displays class conduction statistics of Computer Science and Engineering (CSE) students, taken as sample, for even semester 2020, from 1st year to 4th year considering both online and physical classes.

| Year Semester | Credit Points | Class Conduction | Unit Test Conduction |
|---------------|---------------|------------------|----------------------|
|               |               | Off line | Online | Off line | Online |
| 1st           | 24            | 248      | 192    | 5        | 10     |
| 2nd           | 20            | 208      | 152    | 5        | 10     |
| 3rd           | 24            | 232      | 200    | 6        | 12     |
| 4th           | 12            | 152      | 136    | 3        | 6      |

It is clear from the above data, that the classes conducted in conventional mode using physical board work are higher compared to online classes in all cases, taken mostly in Myperfectice Whiteboard platform. Here it must be noted that in off-line mode 3 classes/lab were conducted upto 2nd week of March starting from the January, compared to 1 class/lab thereafter in online mode.

According to Institute’s autonomy curriculum, 24 credit points normally includes 5 theory subjects with 3-4 labs/week/student. So number of classes conducted/week vary from (30-32), which counts to (360-416)/semester considering (12-13) available weeks. Corresponding statistics which are shown
here are taken from the concerned department’s communicated centralised data which matches with the calculated average values for 1st and 3rd years. But number of class conductions are lesser in proportion to credit points for 2nd year and 4th year as expected.

Regarding attendance, in each stream few students were found who faced gross problems to attend online classes on regular basis because of network issue of their locality. The numbers were variable from (8-10) %. Also some students (around 10 %) missed few classes conducted in the evening time slots as their data pack exhausted the limit for the day. It was observed that most of these students studied through shared study materials as they couldn’t attend online classes.

To check the status of any ongoing teaching-learning semester system in the interim period, normally 2 mid semester tests are taken in the conventional mode in the institute under study. In online mode, 2 such tests were taken for additional supervision in online system along with 1 unit test taken off-line before lockdown. It was recorded that around 75 % students participated in those live online tests on an average in the centralised Myperfectice Whiteboard-conducted unit tests compared to 90% (average), for conventional mode mostly because of the reasons as already mentioned. These cases were addressed later in platforms like WhatsApp and Google Forms, where students participated in the examinations separately with their available network and Data pack.

3.2 Digital Learning Feedback for Online Education

Table 2 shows digital learning analysis based on the feedback provided by the students of CSE, as sample.

| Question responded                              | Total no. of students | Positive response | Negative response | Percentage of positive response |
|-------------------------------------------------|-----------------------|-------------------|-------------------|---------------------------------|
| 1. The Lectures were well planned                | 486                   | 456               | 30                | 93.8 %                          |
| 2. The lectures were clear and easy to understand| 486                   | 406               | 80                | 83.5 %                          |
| 3. The contents were illustrated with adequate examples | 486                   | 427               | 59                | 87.9 %                          |
| 4. The course material /PPT handout was adequate | 486                   | 447               | 39                | 91.9 %                          |
| 5. Assignments were given                        | 486                   | 466               | 20                | 95.9 %                          |
| 6. Online Tests were conducted                   | 486                   | 341               | 45                | 70.1 %                          |
| 7. The instructors encouraged interaction and were helpful | 486                   | 465               | 21                | 95.7 %                          |
Students’ feedback on digital learning clearly indicates their satisfaction on overall teaching & learning during the COVID 19 pandemics. Questions were set including various perspectives of online education where students responded whole-heartedly. But in online test conduction point, they opined somehow differently, which may be related to the fact that the students who live in remote areas, couldn’t participate in centralised online live unit (mid-semester) tests conduction program having interrupted or sometimes no-internet connectivity.

At this point, it is important to look at the institute students’ opinion regarding the merits and demerits of digital learning.

3.3 Opinion of the Students about merits & demerits of the online education system

Students have elaborated their views regarding positive and negative points of online education system as shown in Table 3.

| Merits                                                                 | Demerits                                                                 |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------|
| 1. Virtual Class is good use of new technologies. Digitally the country has been progressed & Digital India concept is well utilised. | All activities depend on internet access and connectivity. So poor connection makes it impossible to join the classes. Audio failure is sometimes encountered in the platform at the time of class conduction as everybody is not having Wi-Fi connection at their home. |
| 2. Digital Education being a structured way of learning, is more engaging if used properly than conventional one and promotes personalized learning. | Even when internet works properly, sometimes students face synchronisation problem between audio and screen visibility. So good connection and sufficient amount of data is needed which many students don't have. |
| 3. Online classes can be recorded for future use which help to go through the same part number of times until it gets clear. | Teaching digitally is not so familiar to most of the students as the regular classes are normally conducted off-line in conventional mode. Face-to-Face interaction between the learner and the course coordinator is more helpful for in-depth learning which students miss in digital education. This is one of the main drawbacks which has to be overcome in digital learning. |
4. Online classes can be accessed on any device like the mobile phone or computer and students can join the classes at any time as per schedule & from anywhere.

5. This is really an excellent idea and good initiative by the college in this pandemic condition to continue with online classes without any break, so that students are able to cover the syllabus properly. It provides an opportunity to learn in different ways.

6. Great for distance learning, where students by sitting at home can attend lectures at their comfort level and able to study without going to College, so no traffic, no pollution.

7. Students are in touch with their study which keeps them busy in this pandemic situation.

Along with students, their parents, very important stake-holders of the institute teaching-learning system also provided their valuable feedback in the online Parent-Teacher Meetings (PTM) organised for the students. Parents of around 90 students of CSE (considered as sample) who participated there, extended their overwhelming support and appreciated the institute initiative to conduct online classes to engage their wards in effective academic programs.

3.4 Conduction of Semester Examination & Online Assessment for Even Semester 2020

As per UGC guideline [5] and subsequent approval by AICTE, the institute under consideration took several steps for conduction of 8th semester online examination 2020.

Accordingly, all the students of B. Tech 4th year 8th Semester, under Autonomy, were notified about their examination conduction schedule during (4th week of June to 1st week of July) 2020, well in time. The examination norms was found to consist of few significant changes to implement new mode of examination during COVID 19 pandemics. The institute settled Online Proctored Mode, with duration of 2 hours for the examination in place of 3 hours in conventional mode. Question pattern shifted from subjective format of conventional mode to objective one with Multiple Choice (4 options) Questions (MCQ) of total 70 marks, similar to that of the conventional mode. Eligible students were asked to appear for this online examination either from home or from hostel/mesh or from College as per their choice, offering the required flexibility as demanded per the situation. 2 MOCK Tests were conducted under the same platform of Myperfectice Whiteboard, to make the students acquainted with the system before appearing in the Semester Examination. Students’ resistance for participation in online examination were thus tackled.

Online Assessment for 2nd, 4th, and 6th Semester 2020 were also done during (4th week of July to 2nd week of August) following the same procedure as adopted for 8th semester online examination.

3.5 8th Semester Result Analysis

8th semester result was published in the last week of July, 2020 which is shown in Table 4.

Along with the stream of Computer Science & Engineering (CSE), whose teaching related data were considered so far as sample, here the results of Information Technology (IT), Electronics &
Communication Engineering (ECE) and Electrical Engineering (EE) students of the College under consideration, are given in the Table 4 below.

Table 4. 8th Sem. result for 2019-20 passed out students whose examination was conducted online.

| Streams | CSE | IT | ECE | EE |
|---------|-----|----|-----|----|
| Grade   | 120 | 56 | 122 | 114|
| 9-10.0  | 99  | 36 | 112 | 108|
| 8-8.99  | 19  | 20 | 10  | 6  |
| 7-7.99  | 2   | 0  | 0   | 0  |

This published final semester result of the test conducted online is probably first of its kind for students of an Autonomous Engineering College, located in Kolkata, West Bengal. Result is interesting. It is found that 82.5% of CSE students, 64.3% of IT students, 91.8% of ECE students, and 94.7% of EE students got grade in the category of (9-10) grade point. Rest of the students got marks in (8-8.99) grade category with only 2 students of CSE are in the (7-7.99) category.

Before going to the discussion of such amazing result, it is better to have an idea of the results of 6th semester and 7th semester of the same batch of students where examinations were conducted in conventional mode. These are shown in Tables 5 and 6 respectively.

Table 5. 6th Semester Result of the same students as shown in previous Table 4.

| Streams | CSE | IT | ECE | EE |
|---------|-----|----|-----|----|
| Grade   | 120 | 56 | 122 | 114|
| 9-10.0  | 32  | 4  | 36  | 7  |
| 8-8.99  | 62  | 33 | 43  | 40 |
| 7-7.99  | 17  | 17 | 37  | 53 |
| 6-6.99  | 8   | 2  | 4   | 12 |
| 5-5.99  | 1   | 0  | 0   | 2  |

Table 6. 7th Semester Result of the same students as shown in Table 4.

| Streams | CSE | IT | ECE | EE |
|---------|-----|----|-----|----|
| Grade   | 120 | 56 | 122 | 114|
| 9-10.0  | 5   | 1  | 7   | 16 |
| 8-8.99  | 74  | 26 | 62  | 55 |
| 7-7.99  | 39  | 25 | 45  | 29 |
| 6-6.99  | 2   | 4  | 8   | 3  |
| 5-5.99  | 0   | 0  | 0   | 0  |
| 4-4.99  | 0   | 0  | 0   | 1  |

Similarly in Table 7, 8th semester result of previous batch of students, i.e.2019 passed-out is incorporated to give an idea about the normal trend of results of the institute on an average, for higher semester students. Here it must be kept in mind that streams’ results vary depending upon the quality
of the students as well as the standard of the questions set for the streams, which might change from batch to batch definitely.

Table 7. 8th sem. result, previous batch, to show the trend

| Streams | CSE  | IT  | ECE  | EE  |
|---------|------|-----|------|-----|
| Grade   |      |     |      |     |
| 9-10.0  | 121  | 54  | 115  | 89  |
| 8-8.99  | 60   | 23  | 83   | 34  |
| 7-7.99  | 22   | 19  | 12   | 51  |
| 6-6.99  | 2    | 6   | 1    | 1   |
| 5-5.99  | 0    | 0   | 0    | 0   |

All of these 3 Tables (5,6,7) indicate that in conventional mode, normally maximum students of the institute score within the range of (7-8.99) irrespective of the streams under consideration from 6th semester onwards, which is equally valid even for different batches. But Table 4 indicates that majority students’ grade point jumps to the range of (8-10) in online mode. These are indicated graphically in the Figures (1,2,3,4) given below.

Figure 1. Comparison of online & offline Semester Examination Result (B.Tech CSE)

Figure 2. Comparison of online & offline Semester Examination Result (B.Tech IT)

Figure 3. Comparison of online & offline Semester Examination Result (B.Tech ECE)

Figure 4. Comparison of online & offline Semester Examination Result (B.Tech EE)
The major reason for this shift is obviously the change in question pattern. In conventional mode, there are Short Answer type questions (15 marks) and Long Answer type questions (45 marks) along with few MCQs (10 marks). But here all 70 marks questions were set as Multiple Choice types where 4th year students scored heavily in the proctored test conducted online.

Here it may be mentioned that as per University Grants Commission (UGC) recommendation, the self-financed Engineering college under consideration, conducted online examination and formalised the evaluation in due time for the benefits of the students which is really praiseworthy as no Government Institute did that unless and until Supreme Court of India gave its verdict on August 28, 2020 to uphold UGC decision to hold final-year examinations by changing its reservation of judgement on the Public Interest Litigation (PIL) [7] filed by some final year students, who demanded the cancellation of their final year examination.

But to maintain the quality of the online examination and evaluation standard, the question pattern needs some modification where in addition to lower levels thinking category MCQs, there must be some higher level questions to address educational learning objectives of Bloom's taxonomy including analysis, application & evaluation-type questions. Such thought-provoking questions require in-depth knowledge of the subjects which ultimately helps students to counter the requirement of the job markets to grab the opportunity, the main motivation behind any professional course students like engineering.

4. Discussion & Conclusion

The outbreak of COVID-19 and the resulting lockdown significantly affected all sectors of the country. The higher-education sector is no exception, which is a critical determinant of a country’s economic future [6]. Closedown of educational institutes lead to two-fold effect on student community where their learning were not only affected but this unprecedented situation created severe mental stress and trauma on student community as a whole. The bigger concern is the effect of the disease on the employment rate where recent passed-out graduates are fearing of withdrawal of job offers from corporates.

But there is another version so far as employment is concerned. India and the world will require more graduates than before from science and technologies who can help to navigate this new normal situation throughout the world. However, these graduates should acquire fundamentally different competencies and need to be educated differently with a broad-based understanding and study of contemporary technologies and society, alongside most importantly, the mindset to deal with uncertainty, to innovate, to self-reflect and collaborate [8]. At this point, it may be included that the institute under consideration, has already started modifying their ongoing autonomy curriculum to include some new subjects highly demanding and required by the industry in the present Post-Covid situation and for the upcoming future.

Also post Covid-19 world would require every organisation to transform digitally from the centuries-old, chalk–talk teaching model. This is already happening but the pace would only increase exponentially. So practical implementation of online examination for undergraduate engineering semester system is a huge step forward taken by the institute under study in this direction.

At this critical period, the open-source digital learning and learning management system could be adopted by the institutional teachers to conduct online learning. It is now clear that society needs flexible and resilient education systems as we face unpredictable future [9] which should include blended learning. There must be the provisions for the laboratory classes and model-based projects, where students may be present physically in small groups maintaining the health-hygiene as
recommended by World Health Organisation (WHO) along with online theory classes to be taken in stable Digital Platform to initiate the new chapter for engineering education.

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