

A study on COVID – 19's effect on Teaching Learning Process in Engineering Education in the Post Pandemic Indian Education Market

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Abstract

As India is moving towards knowledge driven economy, its strength depends upon the capabilities of its citizens. The key to develop a knowledge driven society is to create good Engineering graduates with sound technical knowledge who can be Entrepreneurs, Government executives or even Educators. The pedagogy for engineering education has not changed much in the past hundreds of years. With technology advancements in almost all fields Engineering Education is still practising the age - old traditional teaching methods. To revolutionize Engineering education the integration of technology in teaching methods has become the need of the hour. Also teaching has been one of the professions where the educators never enjoyed longer vacations or work from home due to the rigid brick wall teaching environment. This COVID -19 pandemic has made the entire country go into stages of lockdown. Engineering colleges were closed and the colleges cannot suffer loss of contact hours between the teachers & the students. Hence, the engineering colleges were forced to adopt online teaching methodology with little or no preparation in hand. On the positive side this can be seen as an opportunity to transform towards Blended learning in Engineering Education. This paper aims in understanding the educational scenario world-wide during the pandemic, the problems faced during the lockdown, analysing the factors affecting blended learning and recommends tools and suggestions so that Engineering Education can have a smooth transition towards Blended learning without much hassles.

1. Introduction

When there is panic all over, teachers and students are left stranded about the continuity to achieve the educational outcomes. About 72% of the student population, i.e. 1,268,164,088 of the total learners enrolled, is affected due to the closures in 177 countries as a risk- control measure (UNESCO). When education is disrupted it impacts the economy of the nation on a large scale. The current scenario gives us an idea as to how education scenario in India could change either for the better or for the worse in the long run. While schools and colleges are

equally facing the troubles, Engineering education has taken a major hit as it involves Laboratory work for the application of what they have learnt. Engineers requires laboratories to even do their Final year projects. The digital divide has become more apparent as the world is moving towards online teaching- learning methodologies. This paper discusses the pros and cons of the impact of the COVID pandemic on the education system. The trajectory of teaching- learning process will be impacted due to innovation and digitalization of the education system.

2. Objectives

- To understand the effect of College/ University closures due to COVID- 19 Pandemic on Engineering Education in India and thereby addressing the gaps for continuation of digital aided Teaching in the post pandemic India
- To come out with recommendations for a smoother transition towards blended learning in Engineering Education.

3. Education System Changes World- Wide, During the COVID-19 Pandemic

Education system has seen a very slow pace of change, the system still follows centuries old lecture based approach to Education. COVID-19 crisis has pushed this system to change within a very short span. Though Engineering colleges have moved towards using digital teaching learning process, by the use of Power Point Presentations & Projectors and video lessons, even before the pandemic, it was restricted to only urban areas due to various factors like teachers not willing to shift towards technology use due to their comfort in teaching lecture based classes or lack of infrastructure etc. In the last decade the world has seen a lot of initiatives to change the global level education system but the initiatives wasn't getting a warm welcome by the teachers and the students equally. Corporations worldwide like Google and Microsoft in the United States of America, Samsung in Korea, Alibaba, Ping An and Tencent in China, were trying to initiate a global level education system change.

But to reduce the speed of the virus getting spread when lockdowns were announced, people were forced to opt to more advanced teaching methodologies. Platforms like ZOOM and Google meet were readily available for the teacher's rescue. Here the teachers had to make PPT and present to students and students can get live classes in their smart phones itself. Assignments and Homework's could be uploaded in Google classrooms and the teachers

could evaluate their works sitting at the comfort of their homes. Even reading materials can be posted in these google classrooms.

Now due to this pandemic the changes can be on a larger scale by having cross industry coalitions for a common cause of changing the teaching- learning scenario all over the world. Hence, the education system has force moved towards „learn anytime & anywhere“ concept.

In China, the first country to announce lockdown and other strict measures like school and college closures due to the pandemic, The Ministry of Education has developed a new cloud-based online learning and a broadcasting platform. Also with the collaboration of The Ministry of Industry and Information Technology the country had developed a Suite for education just like G-Suite of the Google tools & Services. Readtogether.hk of Hong-Kong has formed a consortium of about 60 educational institutes, Publishers, Media and also Industry Professionals and they provide Counselling, Educational videos, notes for chapters in books, assessment tools for the teachers for free, they intend to continue this service even after the pandemic is over. Alibaba’s Ding-talk has deployed more than 10,000 new cloud servers to expand the capacity of the platform rapidly. This is one forced change which the pandemic has forced over the country.

4. Adverse consequences of Engineering College Closures during the COVID-19 Pandemic in India

Closures in colleges and universities have impacted the most vulnerable and marginalised students. There are 4 main challenges:

Interrupted Learning: Universities and Colleges provide opportunities for growth & Development for the Engineering Students. Whatever the student learns in one particular semester the application must be tried and understood before going to the next phase. They can do projects & discuss the application of science and also try to create models or work out practically if they are in college. When classes for various subjects can be held online, the application part which is a must for engineering studies will be greatly affected.

Additional Stress on the Teachers: Professors will have to maintain connections with their students to support their learning. When face to face Teaching does not happen the Professors will have to make extra efforts to make sure that their teachings reach all students. This

sudden transitions to distance Teaching- learning could be very messy in the initial stages. If they are not compatible enough the employers might have to opt for furlough of some employees.

Challenges in validating the Student's learning: It will become extremely difficult to conduct and validate the end- semester examinations. When these marks will be highly important for fetching jobs for the final year students, the fairness of the examination conducted and the marks awarded can become questionable by the companies who offer placements. In the absence of hard academic indicators, it would become difficult for the students to differentiate themselves and get themselves a job or move on to higher studies. Chances are that, the students' final performance can be extrapolated with the performance throughout the year.

Parents who were not prepared for the sudden online classes: As the closures were sudden the parents will have to facilitate the online learning of their Children from home instantly. Which requires either a Smart phone or a Laptop and a good internet facility. Most of them would not have required a broadband connection all these years and this would have come as a sudden task which has to be done for the benefits of their children.

5. Effects of the Pandemic on Teaching – Learning Scenario- A Survey

A survey was conducted to understand the effect of College/ University closures due to COVID-19 Pandemic on Engineering Education in India and to address the Gaps in the continuation of digital aided Teaching in the Post- Pandemic India. All the pie charts in this paper and the data has been obtained from the survey. The questionnaire is attached in the Annexures. For this purpose NAAC A++ and NAAC A+ Institutes in Karnataka were considered and 500 plus students and 100 plus Faculties have participated in the survey. When an institution is said to be accredited to NAAC with A++ or A+ then it means that the institutes is said to have best practices which makes the institution create socially responsible students with good Engineering Knowledge and these colleges have fared well in terms of Innovation and newer ideas. These institutes are also the ones who have implemented technology aided teaching learning process even before the COVID- 19 Pandemic had started. Hence, when a college is said to follow Best practices it shows the credibility of that institute, Sawant (2017). Hence by understanding the difficulties of the students and the faculties from these institutions, an understanding can be drawn on the general issues that

most students and faculties in India might face in moving towards a *blended learning approach* after the Pandemic is over.

Blended Learning refers to the type of education which combines online/digital educational method and the traditional classroom based education. The blended learning approach was developed in the 1960's. The sudden outbreak of diseases and distance of the study environment from the student's residence, has led to the development of blended learning. Though it was restricted to audio and video tapes initially, with the advent of ICT, Information Communication technology and its applicability in the Teaching- Learning Process has become a breakthrough for a wider coverage of curriculum, Dziuban et al.(2018).With some control of the place or pace with the student and few most important interactions between the students and teachers a blended learning environment can be created, Siemens et al. (2015). It can also be defined as the integration of the conventional face- to face learning with online or digital learning method Dziuban et al. (2018). As per Graham (2006) it is face- to- face combined with computer based learning whereas as per Garrison & Kanuka (2004) it is a mixture of Face- to – Face and Online Learning. As per Hrastinski (2019) it is a mixture of Face- to- face, Online and Computer based learning. Garrison and Kanuka (2004), had concluded that the Teacher must carefully integrate the different methods of teaching by analysing the practicality of this integration and with respect to their curriculum and resources.

5.1 Factors affecting Online Education during and Post Pandemic Lockdown

Online Education can be affected by several factors like Students, Teachers, Technology, Individual Learning Styles, expected outcome from the teaching, Teaching styles and psychological factor of the teacher. In the current paper the two main factors are considered, the students Factor and the teachers Factor and the relationship of technology and psychological effects on these two factors are studied. Understanding of these two factors will give a concrete idea of the ways to make Blended Learning successful if it is infused into the normal teaching methodology in the Post Pandemic scenario. Fig. 1, will give an understanding of the content to this section.

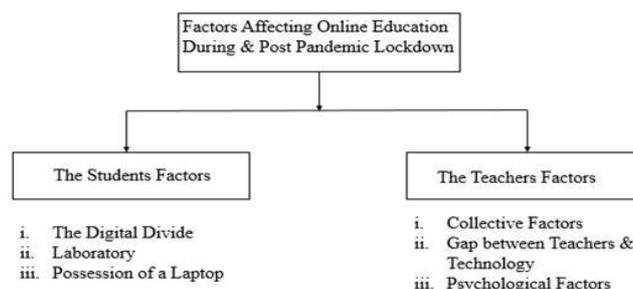


Fig. 1 Flow Chart of Factors Affecting Online Learning

I. The Students Factor

It is important to understand the factors which affect the students' online learning possibility during this lockdown so that moving towards blended learning will be easy by eliminating the negative factors.

i. The Digital Divide

Students from financially better households can afford to shift towards newer technologies whereas students from poor background will be left behind. The initial cost of digital devices and the data plans will have to be reduced if the benefit of the new blended education system is to be introduced for the Post Pandemic India. To make blended learning a vital option during normal days, it is important that the students must have a proper broadband connection. From the survey it was found that during the lockdown 72.9% students didn't have a broad band connection, refer Fig. 2. It should also be mentioned that after the implementation of the lockdown only 36% students stayed back in Bangalore. Whereas the rest of the students were in other places. It can be noted from the Fig. 3. Around 36.8% students had a village background and it is understandable that, network might be very weak. In a research conducted by Diwakar et al. (2016) the researchers' correlated learning issues while using remote labs to poor internet connections.

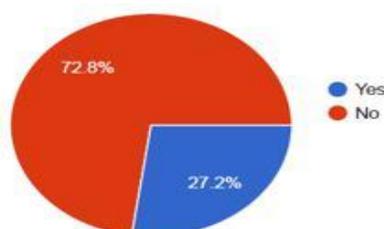


Fig. 2 Availability of Broadband Connectivity

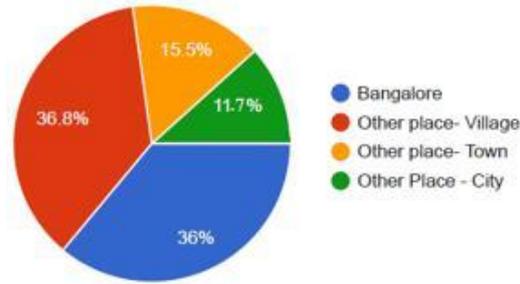


Fig 3 Place of residence during lockdown

ii. Laboratory

When classes for theory and problem based subjects can be effectively handled using online platforms, labs cannot be handled with such an ease. Departments like Civil and Mechanical have extensive laboratory practises in all semester till the 7th Semester. Virtual labs would not yield the satisfaction of what a real lab with machineries and equipment can provide. Hence, in the future when classes can be help online, for labs the students will have to attend the physical classes.

iii. Possession of a Laptop

From the survey conducted in this research, only 39.5% students have a personal laptop. 60.5% Engineering Students in the current survey did not possess their own device, Fig. 4. Hence, this is one major problem which is needed to be addressed if Blended Learning is to be brought into system Post Pandemic Also as per Diwakar et al. (2016) Device failure was a huge cause of interruption in remote education. So it can be said that, even though 39.5% students in the current survey have laptop, in the case of a device failure studies of the ones having the device will also be affected.

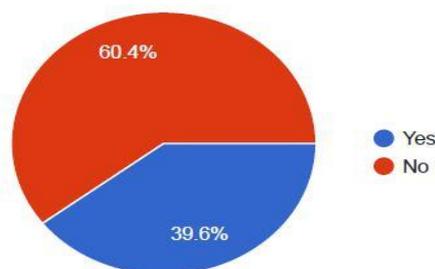


Fig. 4 Percentage of Students in possession of a Laptop

II. The Teachers Factors

The teachers factors are analysed from both technical & psychological aspects as explained below.

i. The Collective Factors

Teachers online teaching can be affected by several factors like, possession of a laptop, broadband connection, hose hold work at home, effect on productivity because of being with kids & Family & the inability to focus on the weak students.

From the current study it was found that 9.1% of faculties did not possess a laptop, and 33.3% of Faculties had laptop at their home but all other family members also use it, Fig. 5. About 36.4% of faculties did not have a broadband connection and were depended on their mobile network alone, Fig. 6. These factors can be addressed by formulating a plan by the institutions to provide laptops for work purpose and broadband allowances to the faculties.

In the participants of the survey 45.5% were female & 54.5% were male, Fig.7. About 33.3% of the people had claimed to do all the house hold chores all alone, Fig. 8. About 69.7% of them stayed with their kids, Fig. 9 and around 27.3% of the faculties had kids, whose age was less than 5, Fig. 10. These all factors might restrict a faculty to perform well from home taking Indian scenario into consideration.

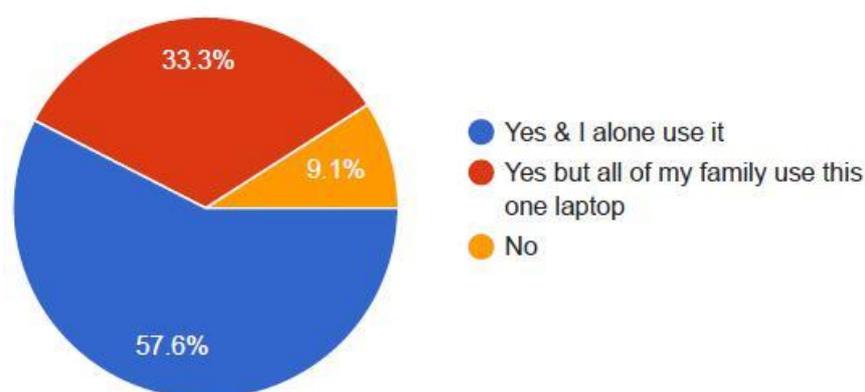


Fig. 5 Percentage of Faculties possessing a Laptop

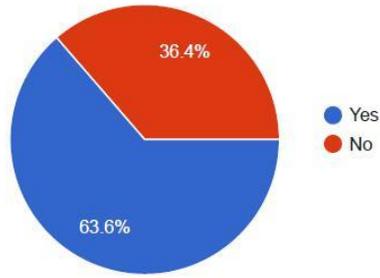


Fig. 6 Broadband Connectivity

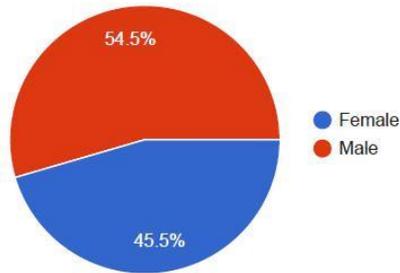


Fig. 7 Gender

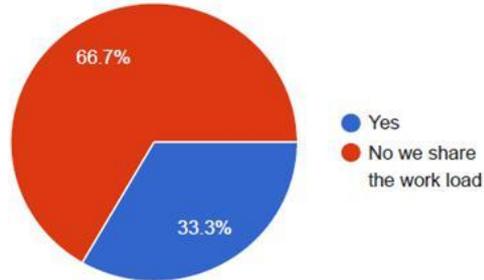


Fig. 8 Percentage of Faculties doing their house hold chores alone

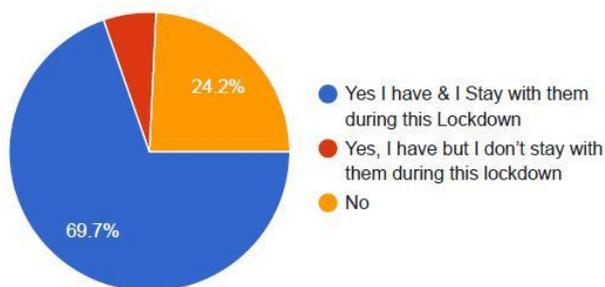


Fig. 9 Percentage of Faculties staying with their kids

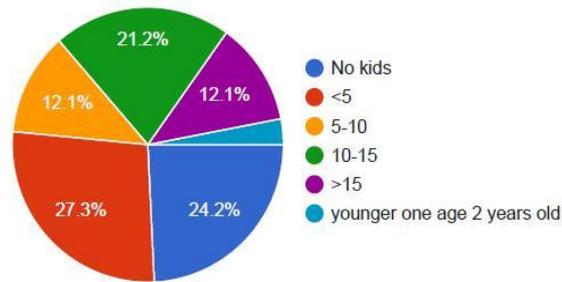


Fig. 10 Age of Kids

ii. Gap between Teachers & Technology

As per Wikramanayake (2015) Traditional Chalk- Board teaching requires both the teachers & the Students to be in the brick classroom & is restricted to textbooks, but the advent of newer technologies has paved way for all to access learning materials online regardless of the distance. But to tap this opportunity it is important to understand the technology readiness of the Faculties. From the survey conducted it was found that 33.3% of the faculties use the traditional Chalk-board teaching method, from Fig. 11, about 75.8% faculties have never handled online classes before the pandemic, from Fig. 12, about 15.2% faculties were not good in making Presentations for the online teaching method, from Fig. 13, about 9.1% faculties did not know how to record educational videos, Fig. 14 and most of all 21.2% of faculties have never attended an online webinar session, Fig. 15. From this it can be collectively said that, to implement Blended learning in the Post pandemic educational market, it is very much essential that this gap in technology & the faculties must be addressed. It can be addressed easily by implementing a compulsory basic training program in using technology in the above mentioned areas.

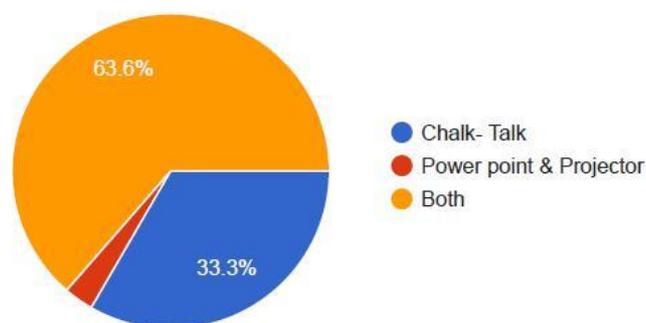


Fig. 11 Teaching Methods generally followed by the Faculties

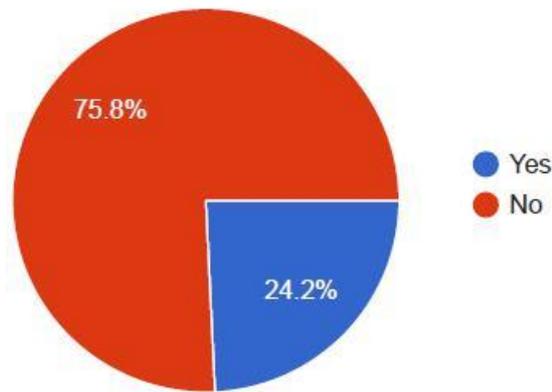


Fig. 12 Percentage of Faculties who have handled online classes before the Pandemic

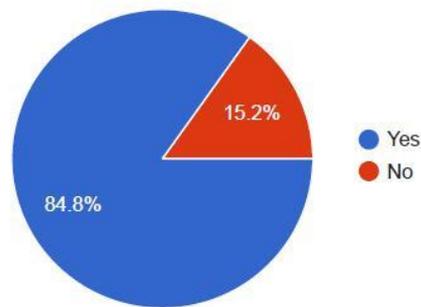


Fig. 13 Percentage of Faculties with knowledge on making presentations for online lectures

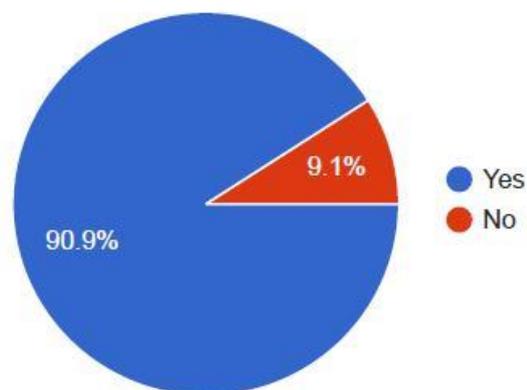


Fig. 14 Percentage of Faculties with knowledge on making educational videos

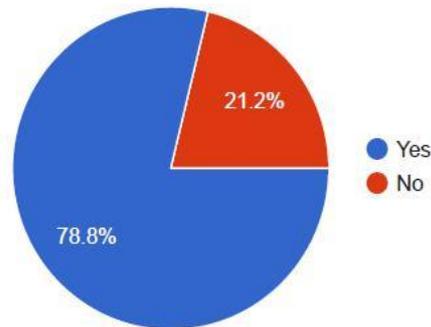


Fig. 15 Percentage of Faculties who have ever attended online Webinars before

iii. Psychological Factors of the faculties

Faculties might feel uneasy & unprepared for the challenges in online teaching, it might range from lack of tools to their persona in traditional brick classrooms Major (2010). Inan and Lowther (2009) had reported how the individual characteristics of teachers & perceptions influence the technology integration. Findings show that their work environment influences the faculty's proficiency and also their readiness for the integration of technology in their classrooms. The research paper of Vaughan (2007), considers it important to deal with the Faculty's fear about loss of control, lower feedback, lower grades and their uneasiness about online teaching. Hence, it can be said that the psychological factors play a vital role in making the faculties adopt Blended Learning in the post- pandemic environment too.

In the current study it was found that, 54.5% of the faculties did not feel this method of teaching as effective. The silver lining in this is there are 45.5% faculties still feel strongly motivated and feel that this method works best for them, Fig. 16. Also 39.4% of the faculties felt that their research productivity is hampered working from home though they were able to teach from home, Fig. 17. A major point to be noted was that 60.6% of faculties felt they couldn't focus on the weak students in this method, Fig. 18. 48.5% of faculties have reported that they travel for more than 30 minutes to 2 hours and thus this travel time can be greatly reduced when online learning is implemented, Fig. 19.

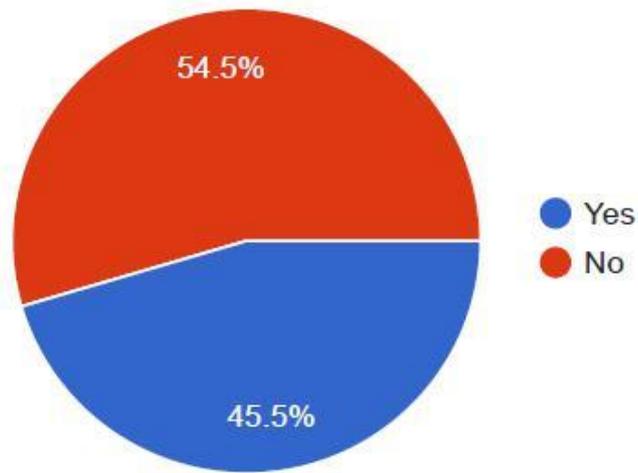


Fig. 16 Effectiveness of online teaching methodology

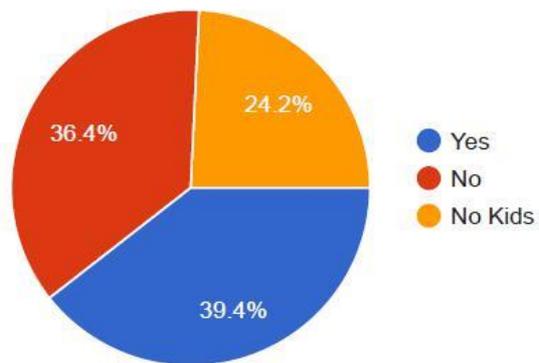


Fig. 17 Research Productivity Efficiency when being with kids

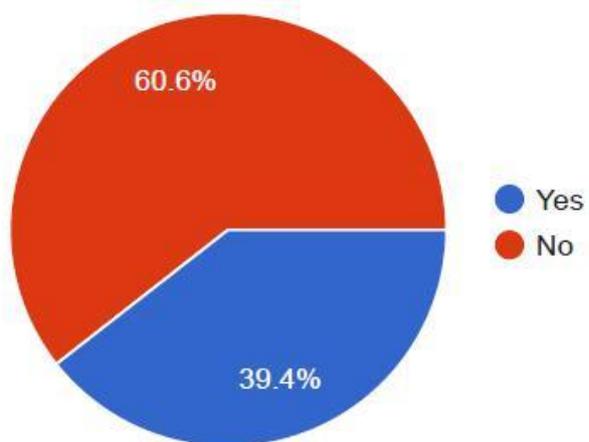


Fig. 18 Focus on Weak Students

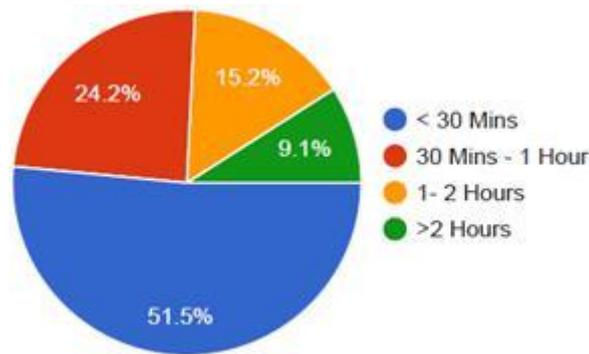


Fig. 19 Travel time

Advantages of Blended Learning

Blended learning has several advantages like the teaching process can be shorter and content oriented rather than traditional lectures, also it offers flexibility for learners to access the resource materials from anywhere and anytime and later on discuss the problems faced in understanding that particular concept. Few major highlights here are the Global level integration of teachers inside the brick wall classrooms, self- paced learning, and due to blending of various methods information retention increases. In this report three main advantages are presented below which may be the vital components for welcoming this transition in both the students and teachers levels. These advantages can act as a reward for transforming towards Blended learning approach.

Addressing the Gap between Classroom& Industry

When Traditional teaching methods and the modern online teaching is blended correctly then a new and more interesting teaching- learning process can be created in the future. Colleges & Universities can look forward to sign MoU's with foreign universities so that, technologists & teachers from other countries who cannot be invited to Indian colleges due to visa and availability of time issues, can be asked to provide Online lectures and hence the quality of Engineering Education can be made even better in the future.

With publishers, Governments, technologists and Industry people participation in classroom education through online platforms, the gap between engineering education and the industry standards can be greatly addressed. It will be a lifestyle change to learn through online platforms after the pandemic is over.

Longer Vacation

From the survey conducted it was found out that, 63.8% of students come from their houses in the city, and 36.8% either stay at a hostel or paying guest accommodation or a relative's home, which can be seen from Fig . 20. Hence, if Blended learning is incorporated in the usual academics then the students who leave their parents for their studies, may get additional time to stay with their parents in between semesters also. In this case, the teachers must plan the course delivery, in such a way that the online classes for the possible topics, can be covered during festival holidays and even before and after such holidays etc., this way both the Teachers and students can avail a longer vacation in between the semester too.

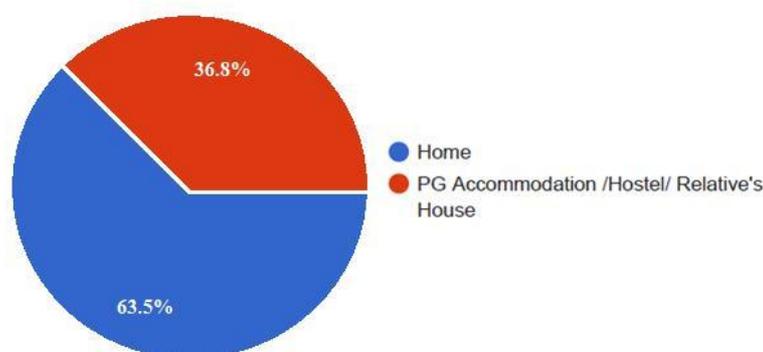


Fig. 20 Place of residence to attend the college

Work- From home revolution for Teachers

In the Traditional teaching- Learning Methodology the teacher's physical presence was very much required and teaching was one such job which never had the benefit of work from home. The Management of Educational Institutions, Students and parents were not ready to adopt the online learning platforms because they never knew what the outcome of this exercise will be, and this Pandemic has been a driving force in making everyone aware of the online learning platforms and hence, the teachers can enjoy the benefit of work-from home at times after the pandemic is over.

Immediately after the lockdown will be eased there is a possibility that even though companies and manufacturing units might start to work, Schools & colleges might have to be closed for the safety of the students. Parents whose work is based on IT Sector can avail the benefit of work from home whereas Single parents who are Professors and teachers who have

migrated away from home might have to find alternatives for day- cares and it is to be noted that in the traditional teaching, as their physical presence is required they couldn't have afforded the benefit of work from home and should have settled for unpaid leaves or worse should have risked getting removed from jobs. This adoption of Online Teaching Methodology during this COVID-19 pandemic has been a boon in the times of adverse crisis. Professors too can now avail Work from home benefits in such times of emergencies. This benefit can be availed even after the Pandemic after the successful planning of integrating Blended Learning in the teaching methodology.

6. Tools for Blended Learning in Higher Education

The faculties have a varied option to choose the tool which suits for their purpose a few examples are listed below

Government Initiatives: MHRD has the following initiatives for higher education which the faculties can tap as per their use. SWAYAM - MOOC portal, Swayam Prabha a Free DTH Channel for Education, NDLI - National Digital Library of India, Virtual Labs, e-yantra, FOSSEE- Free and open source software in Education.

Online Classes: Platforms like Google meet, Google classroom, Zoom platform, YouTube-Live etc

Online Engineering Videos& Laboratory videos: NPTEL Lectures& NCTEL videos

Making Educational Videos:MS Office- Microsoft Power point (after version 2013) and Windows Photo story Maker

Video Editing: Photos app in Windows 10 and In Shots

7. Recommendations& Conclusions

- To reduce the digital divide, a proposal to the Government can be raised to give students of engineering colleges" a discounted Wi-Fi device with a minimum data plan which will be sufficient for the students. A plan of deactivating the device after the period of study or drop out should also be available and ban on Social media and

other irrelevant sites should be enforced on such devices. The distribution & the deactivation should be handled by the management of the institutions.

- The management of Engineering Institutions can take a sum of money towards procuring & distributing Mini- Laptops for the students who take admissions to their institutes. When orders are placed in huge numbers, better discounts and affordable price can be availed on the Mini- Laptops can be availed and that will reduce the price of the devices.
- A similar approach can be taken towards the faculties who do not have laptops. The faculties can be given mini- laptops at a discounted price and the money can be deducted from their salaries in 3- 6 months. By this way it wouldn't be a burden on the faculties too.
- The faculties can be given "a broadband allowance" an extra allowance just like transport allowance, so that the broadband issue can be resolved.
- For Engineering Education it is impossible to go completely online and hence with respect to Labs, proper planning for blending of the three namely laboratory sessions, classroom sessions and online sessions must be done. It can be noted that Planning is the key for proper Blending.
- It is in the hands of the administration to make sure that the blended learning is not a onetime strategy and it should be made sustainable by creating reusable resources which can be shared digitally.
- Faculties/ Professors must be given two types of mandatory training, (i) **Tech- Based Trainings:** Basics of using MS office, using online platforms, recording and editing videos, using MOOC and videos to teach and (ii)**Plan&Execute Trainings:**on how to plan, and execute blended learning according to their curriculum a step by step approach must be thought.
- A proper mechanism of feedback from both students and the Faculties must be chalked out to monitor and rectify errors in the formulated approach. It is very important to understand the effects of face- to face interactions about the online methods with the students, so that it will provide the comfort of the normal teaching methodology which they are accustomed to Garrison and Vaughan (2008). Also As per Little John and Pegler (2006) it is important that a strong integration between the classroom and the online environment must exist for a successful Blended Learning Eco-system.

- The proposed *PDP model*. A good blended learning Ecosystem in Engineering Education must have the following 3 stages: **(P)***Pre delivery Stage*, **(D)***Delivery stage* and **(P)***Post-delivery stage*.

Pre Delivery Stage: The planning must be done. The faculties/ professors can discuss with other faculties in accordance with their syllabus and understand the options which they can use for their teaching. The faculties must be given freedom to choose the tools & platforms required for their teaching methodology. Making of appropriate Slides, creation of relevant educational videos and other contents must be done during this stage. For every class the scope of that class and the goal intended to be achieved must be created.

In the delivery stage: During this stage it is very essential to make the students understand the importance of why the Faculty has chosen that particular method of delivery for that particular topic. It is important that the teacher explains the goals they intend to achieve in that class. This orients the students towards what the faculty tries to achieve and also doesn't give space to distractions.

In the Post- Delivery stage: The faculties must take feedback for every topic they have used a different approach other than the traditional teaching. Once the feedback is got, it is necessary to act as per the feedback to give the students a sense of importance. Also a feedback test or quiz must be given to analyse the level of understanding by the students and if the faculties feel that the goal of that class is not attained they might have to teach that particular topic again.

Conclusions

- The effects of the sudden closure of colleges due to COVID-19 pandemic was analysed through a survey of NAAC A+ and NAAC A++ engineering college teachers & students.
- Recommendations were highlighted for a smooth transition towards blended learning and a PDP Model was proposed as a guide for the faculties who switch towards blended learning in the Post – Pandemic education scenario.

10. Further Scope of Studies

- Models can be created for different engineering streams and their effectiveness can be studied through case- studies.

- Understanding of students and teachers needs after the implementation of blended learning in Indian Scenario can be done in the Post- Pandemic Scenario.

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