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A REVIEW ON - CHALLENGES IN REMOTE LEARNING FOR ENGINEERING EDUCATION CAUSED BY THE COVID-19 CRISIS: METHODS AND ITS APPLICATIONS IN LECTURES, LABS, TUTORIALS, AND ASSESSMENTS

Ms. Nileema P. Gaikwad[1], Ms Nita Dimble[2] , Ms.Dipali I.Ghadge[3]

[1]*Assistant Professor, Rajarambapu Institute of Technology, Sakharale, India, 415409*
[2]*Assistant Professor, Flora Institute of Technology, Khopi,Pune, India, 412205*
[3]*Assistant Professor, Rajarambapu Institute of Technology, Sakharale, India, 415409*

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Abstract: Many educational institutions were forced to convert from traditional physical classroom training instruction to an online model due of the COVID-19 pandemic. To offset the negative consequences of a covid 19 on engineering students, which has traditionally been content based, physical, and lab-oriented, immediate and meticulous planning is required. Higher education institutions have made it a priority to improve and enhance education in order to give better learning approaches, technology, educators, and knowledgeable students to meet the needs of industries and enterprises. Engineering Education and Computer Science Teaching and Learning are two areas where considerable improvements are required. During the COVID-19 outbreak, this research investigates the influence of online training and labs as a result of "COVID 19." It's crucial to examine the rise of online technologies and apps for online training, as well as their affect on engineering training. The goal is to develop a solution to the problems of continuing to educate and learn throughout protracted academic interruptions caused by this unexpected pandemic. In developing countries, several problems include the lack of internet connection throughout the nation and the lack of resources available to huge communities to earn and study during COVID 19. During the global pandemic, this paper presents several policy requirements for online engineering course delivery and assessment methodologies. These standards will serve as a road map for high-quality online engineering course teaching and evaluation.

Keywords: *Engineering education, remote learning, online meetings, virtual labs, COVID 19*

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INTRODUCTION

During the COVID-19 outbreak, kids used the phrase "study from home." Millions of students and faculty members throughout the world have converted from traditional face-to-face (FTF) settings to online tutoring/DL mode to counteract the spread of COVID-19. Because online learning is already well-known among academics, the current situation's primary challenge is determining how to transfer from a physical to an without putting students or teachers in danger. Regardless of the issues we encounter in other areas of learning, our primary focus is on the shift in engineering education that has had a major impact, where theory and lab work together to inculcate design and development (D&D) aptitude. Engineering education is a tough field that requires the well mixture of classroom instruction and well-coordinated lab sessions. As a result of innovation and growth in information technology (IT) infrastructure, the today is a global society. As a result, online education courses can be developed to provide students from all over the world with access to the world's greatest instructors. Apart from the psychological stress caused by lockdown and social isolation, engineering students, particularly new ones, must enrol in online programming to keep themselves occupied with learning new topics, resulting in improved moods and retention rates. Additionally, international agreements among universities (with equal engineering degrees) can be created to enable students from underdeveloped nations with remote laboratory access, allowing them to use a lab facility in a technologically advanced country. Universities must offer infrastructure, training, and policy guidance to all faculty members on how to perform online academic activities during the COVID-19 emergency in such instances. Universities, on the other hand, must seek to ensure that DL academic activities are consistent and of high quality, bringing them up to pace with onsite (FTF) education. The following is the structure of the paper: The following part looks at the online learning environment in engineering and the advantages of online teaching for engineering students. The next section looks at the limitations of online classrooms and online laboratories, with a focus on alternate teaching tactics during the COVID-19 pandemic. Finally, the document's final section draws the manuscript to an end. Engineering courses are available totally online. Engineering education has certain distinct traits when compared to non-engineering subjects. Students must develop a design approach by learning theory and basic concepts in the classrooms, followed by practical experience in the lab for

psychomotor learning, in order to empower themselves to address real-world challenges.

Online classroom

Internet meetings, in which students and lecturers are not physically present, are held utilising online programmes such as Zoom and Google. Online platforms and information technology (IT) infrastructure play a key role in such agreements.

Virtual labs

Engineering laboratories are significant parts of the curriculum because they require students to apply what they've learned in class. To offer students with all of the necessary lab equipment, these meeting spaces are produced artificially via the internet. One example of this type of model is the design and construction of an interactive virtual control system lab for electrical and computer engineering undergraduate students. 16 These platforms are also used to demonstrate important topics in mechatronics engineering using an online DC motor test bench.

Role of Staffs

Teaching staffs play a crucial role in ensuring that students obtain a high-quality education in any educational system, whether online or offline. In online education, staff members' tasks become even more vital to ensure that at least a basic level of quality is maintained in the delivery of online courses. Faculty members should improve their skills by participating in E-learning capacity development programmes.

Quality norms in DL*:*

It is vital for teaching professionals who are involved in online education to adhere to the norms of the system. Creating effective course structure, sharing weekly structure with students, taking care of weekly lecture activities, keeping track of student attendance, creating effective presentation items, creating course evaluation rubrics, and, most importantly, evaluating the entire process through periodic student feedback to improve the quality of online teaching are all included in these guidelines. A teacher must know that several aspects of distance learning may differ dramatically from traditional FTF instruction.

Building a Capacity:

Faculty members should participate in capacity-building programmes related to the fundamental usage of online teaching applications, online course design approaches, and online teaching pedagogical abilities, it is vital to emphasise. Maintaining a weekly lecture track is critical to maintaining quality. Teachers must keep statistics on the number of online meetings held, tasks done during the week, topics covered, study materials provided online, and any other online learning tool used for this purpose up to date on a regular basis.

Engagement of Student's:

A teacher who uses e-learning as a method of instruction must figure out how to keep pupils interested. Because students are participating in an online meeting from afar, it is critical to keep their interest and enthusiasm for learning alive. Students should be given the opportunity to speak up by establishing discussion rooms and discussion forms. They must also be encouraged to communicate their ideas and issues, and they must be provided enough guidance to tackle these obstacles. In simulating a true classroom situation, students should be able to communicate with their peers. In addition to standard lectures, instructors should point students to various online resources related to the course that are available on the internet; this will motivate learners to get their own research.

Online Course Planning

To achieve excellence in online teaching and raise student interest, the best methodologies should be used to create rising online courses. A welcome message should display before a brief introduction to the course and the instructor in an online course. A virtual course tour can provide students with first-hand knowledge of the content, making it more interesting. It is recommended that all relevant course information, such as prerequisites, purpose, structure, and policies, be displayed. Assessments, course structure, and teaching/learning activities must all have clearly defined learning objectives for students. Students should be informed about the assessment process, and all registered students should be informed about a well-defined, transparent analysis grading plan. Both the instructor and the students should be able to track their progress as the course develops.

The teacher's materials should be current and communicate the most up-to-date concepts in any subject. For the shared web resource, the teacher should provide relevant degree citations. Students should have several opportunities to interact with the teacher, their classmates, and the course content, so the course should be developed and delivered with effective pedagogical techniques in mind. This could be achieved by incorporating active learning activities that stimulate participation from students, instructors, and the course as a whole. Discussion boards, assignment comments, live sessions, and one-on-one student email responses are just a few of the activities that make up a large portion of every well-designed online course. The technology employed is defined by the restrictions and availability of the technology used to create such an active learning environment. Every student should have access to the technology and software required for virtual instruction and learning. A tutorial on how to use these technology tools should be included in training. The instructor must make it clear how

academic support services can assist learners in the event of technical difficulties.

Flexibility of Time:

The major value of asynchronous online learning is the scheduling flexibility it offers both faculty and students. Teachers can share pre-recorded recordings of their lectures in asynchronous mode at any time, enabling students to watch them whenever they choose. Unlike traditional FTF training, when missing a class means losing the material, students watch recorded lectures multiple times to refresh concepts taught in the lecture. Quizzes, assignments, home works, discussion forums, and other assessment items are uploaded to the e-learning site by the teacher, and students can attempt them within a specific timeframe. This clarifies things for students in rural regions who are concerned about network connectivity. They can choose a time when the network would be available and then attempt the evaluation items at that time. Furthermore, students in remote locations with limited bandwidth prefer asynchronous mode because discussion boards and other features require much less bandwidth than live streaming lectures using various video tools, as discussed in the section titled "Survey of tools available for online teaching."

Online classroom: Synchronous mode

Synchronous online teaching, in which the teacher interacts with the students via video links by using various tools mentioned in the section 'Survey of tools available for online teaching,' is a more realistic method of online teaching. This type of learning may be more interesting and useful for students, but live sessions must be carefully scheduled. A time must be chosen when the majority of students will be able to connect. In synchronous education, low bandwidth and unreliable network connections could be major roadblocks. As a result, imposing the same class schedule as FTF learning may be challenging, as peak network congestion occurs in the morning hours, and connectivity in heavily populated regions is restricted. and far regions is poor.

In synchronous mode, the teacher must prepare all course resources, such as power point presentations, video demos, lecture notes, and so on, in advance of the live session. If the lecture materials (PowerPoint/pdf slides) are uploaded to the LMS e-portal prior to the beginning of the course, it will be effective for students. The learners in this situation are familiar with the content of the upcoming lesson. During the live session, students should be able to communicate with the teacher using video conferencing technologies, such as raising their hands and unmuting their microphones. If the session is being videotaped, students should be made aware of any potential privacy issues. The instructor should reply to all of the questions raised in the chat box after the online session. To save time, similar questions could be combined into a single response.

Independency about location

Students' presence does not need to be physically limited in attempt to benefit from online courses; they can be anywhere as long as important communication techniques are developed.

Ease of Access:

Students can attend lectures whenever they choose because they are available online 24 hours a day, seven days a week. People can now learn from the comfort of their own homes.

Effect on Student Learning:

Online education's short- and long-term implications have been researched. Students' online learning activity doesn't really appear to alter short-term learning outcomes. Instead, it has a massive impact on long-term learning outcomes.

Cost effective

The cost-effectiveness of online learning cannot be overstated. Due to lower electrical and HVAC demand, the university saves money on electricity costs. Less travel minimises pollution, which is beneficial to the environment, society, and economy. Furthermore, in the case of online (paperless) tests, a significant reduction in stationary expenses might be expected. Because of these facts, the majority of low-budget colleges around the world, particularly those in developing countries, have opted for free online e-learning technologies.

Limitations of online meetings and online labs

The country's information technology (IT) infrastructure is the most important factor for entirely moving from traditional classroom to online tutoring. A well-designed standard operating procedure (SOP) for conducting online classes while meeting quality requirements is also required in engineering education.

Requirement of Hardware

The minimum prerequisites for establishing an online e-learning environment in faraway classes range. A laptop with a core i5 CPU and Windows 7 (or above) operating system may be considered the minimal needed for doing online lessons in today's climate. On the receiving end, students can utilise a digital tablet, but they'll need desktop/laptop computers with internet connectivity to perform simulations and complete assignments and presentations.

Limitations of Softwares

There are certain limitations to some of the free online teaching resources. The free Zoom session, for example, only allows for a 40-minute class time. Similarly, the free edition of Microsoft

Teams can only manage 50 users. MS Teams' user interface, according to some users, is less user-friendly than Zoom's.

Internet Speed

For online remote classes and virtual laboratories, broadband internet is the best alternative. However, delivering online classes necessitates a large amount of internet bandwidth, which is difficult to come by in impoverished countries. Students in remote areas can only obtain lecture slides and audio from previously recorded courses via email. In such cases, lecture CDs can be mailed to students in far-flung areas of the country.

Teaching faculty limitations

The institution requires faculty and lab engineers who run labs to complete online education training. Because they are accustomed to teaching largely in FTF mode in their regular teaching practise, online/DL teaching becomes a nightmare for some of the technology-deprived faculty members.

Online Attendance

Attending online classes on a regular basis is an important metric for academic performance. Students entering and exiting remote classrooms can be tracked using a variety of techniques (synchronous mode). In order for their attendance to be automatically documented, they are frequently requested to input their enrolment ID in the chat box. The attendance method, on the other hand, is difficult to sustain in the case of pre-recorded lectures (asynchronous mode). Students could be requested to fill out a questionnaire based on the session's topic at the end of each lesson. This response must have a time limit so that attendance can be logged.

CONCLUSION:

During the COVID-19 crisis, this study investigates online teaching and learning practises in a variety of engineering programmes. As a result of this problem, new dimensions in online engineering course teaching have been discovered, as well as the adoption of various distance-learning teaching and assessment methods. The DL mode is utilised in an online setting to profit from understanding and executing fundamental engineering concepts. An OCDM for evaluating online teaching preparation is emphasized as crucial for maintaining quality through certifying online courses at various levels and using student feedback as a critical performance indicator.

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