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An Empirical Analysis of Online Engineering Education during Lockdown Due to Pandemic

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***Abstract*:** With the rapid growth in internet and wireless communication technologies, online education is growing exponentially. The Covid-19 pandemic has revolutionized online education tremendously. The abrupt conversion from conventional face-to-face instruction delivery methods to online mode, compelled the teachers with limited skill, develop, deliver the content, assess and grade the students. This lead to various challenges for medical, science, engineering, arts, commerce and other vocational education sectors. The challenges faced by students and teachers are to be addressed for successful implementation and growth of online education. The common challenges like network connectivity issues, lack of appropriate electronic gadgets for learning, security and privacy concerns, difficulty in maintaining focus, socialization with peer group , lack of physical activities due to lockdown lead to health (physical and emotional)issues . For maximum efficacy of online learning and improve the learning outcomes, these challenges have to be addressed. The engineering education involves experiential learning along with conceptual understanding and numerical analysis associated with research oriented study. This makes it even more challenging for the online teaching- learning process. This survey based quantitative study is aimed at investigating the factors that affected the students and teachers while online classes were conducted for descriptive, numerical, analytical, and both hardware and software laboratory courses during lockdown. A total of 34 teachers and 178 undergraduate students participated in the survey from The Electronics and Communication Engineering (ECE) , Electrical and Electronics Engineering(EEE) and Computer Science Engineering (CSE) disciplines. The data collected is analyzed to understand the factors affected their education and improve the quality of online education in the days to come. We explored the challenges and discuss solutions for various types of engineering course specific to circuit branches of engineering programs.

***Index Terms**: Covid-19, Conceptual understanding, Experiential learning. Quantitative study, online education,*

1. Introduction

The global outbreak of the pandemic and the closing down of educational institute's worldwide to flatten the growth curve of COVID-19, thereby controlling the spread of pandemic, lead to online education worldwide. Along with public care strategies like hand washing, wearing of face masks , physical distancing in public places and avoiding mass gatherings of large numbers unless it is necessary or limited movements etc. to curtail the spread of pandemic, we were compelled to continue the teaching learning process with the available infrastructure facility and limited skill set for online education[1].

To continue with educational activities in spite of these challenges , the institutes abruptly started online education through existing infrastructure and online educational platforms like Zoom, Microsoft teams, Google meets, Webex, etc[2]. Through these platforms the content development and delivery was challenging from the

skill set required for faculty to transform teaching from face-to-face to online mode. Also from a course learning perspective as well. As engineering education demands more of hands-on skill learning than theoretical learning, the conduction of the practical (hands-on sessions) was more challenging for engineering programs[3]. Engineering education basically involves theoretical study of some courses where the concepts are studied in depth[4]. Then some mathematical concepts for mathematical modeling of systems and analysis, the research oriented study for building new ideas and systems. To put all these ideas into practice hands on, experiment based study both in hardware and software skill development is essential.

The course content developed and delivered should cater to the above needs of the learner community and reach out to the entire community [5]. The teachers without any formal training and with the existing infrastructure facility and skillset in developing descriptive, analytical, numerical and h/w and s/w practical based content found it challenging. For students on the other hand, concentration for long hours, no socializing with peer community, zero physical activities lead to psychological anxiety, communication issues etc.

Despite the existing literature on online engineering education, to the best of our knowledge, there has been no thorough (quantitative and qualitative) analysis of challenges and solutions for future growth of online engineering education worldwide, that were mainly offering face-to-face classes pre-pandemic[6,7]. This work is aimed at analyzing the various challenges associated with circuit branch engineering education which involves theoretical, mathematical, analytical, practical hands on learning both in hardware and software courses. The inputs are collected from both teachers and students for the growth of future online engineering education.

The ECE and EEE discipline courses mainly belong to any one of the following types or any combination of these. They are 1) Descriptive /Theoretical Type - this type of courses cover the concepts, principles and theory 2) Analytical/Research - this type of courses cover the analytical approach, new ideas to be developed for inventions 3) Numerical Type of courses - this type covers Numerical analysis and mathematical modeling of systems 4) Hardware laboratory courses - this type covers hands on experiments and help in understanding the industry requirements 5)Software laboratory course- this type covers the study of simulators and software skills.

All these courses are essential for an engineer to develop concept building, innovate new ideas and provide solutions to new age problems, respond to societal issues as a problem solver, in building innovative systems etc.

The online education in engineering should facilitate these skill building [8]. We have tried to investigate the challenges in online education to provide the above mentioned assistance. Also suggested the way forward for making OEE (Online Engineering Education) successful.

This paper is organized as follows: part 2 deals with literature survey, part 3 deals with methodology, in part 4 results are discussed and the last part presents the conclusions of the work carried out

2. Literature Review

The online education is being accepted by educational institutes, employers and learners alike. There is no extensive research carried out for all the education sectors including professional courses, arts, science, technology, culinary skill development, sports, music, dance etc[2]. The literature survey carried out in this work regarding engineering education gave insight for further work to be carried out in this area.

In[1] authors have highlighted the benefits and challenges of online education. The benefits like anybody interested in upgrading skills, including working professionals can learn through this at their own pace and time and save money as well.This helps in meeting ever changing industry demands and bridge gap between education level and industry expectations. The challenges presented by authors are insufficient infrastructure, limited social interaction, credibility of degrees, higher level of self motivation and time management, independent working strategy and organized working style requirements etc. It also provides lot of opportunities for investors. In [2] The author's urge to teachers and students/ learners to continue and explore the use of different online educational tools even after the COVID-19 pandemic , when the normal classes resume. In

future the online education is going to survive and transition to online education is inevitable. In [3] authors opine that the laboratory and team work related courses were most negatively affected by the transition from the face-to-face to remote instruction mode. The reasons sighted for this are the instructors are not skilled enough to deliver such courses and the software tools available were not sufficient enough for this.In [4] the author has discussed the short term and long term impacts of online education. Also the various challenges for economically, emotionally deprived learners, expressed concerns over increased dropout rate in higher education due to lack of digital facilities.In [5] authors present some strategies for engineering education that Learning Mangement System (LMS) should be adopted bt the institutions for managing course, forum discussions. exams and grades. Faculty should develop necessary skills to develop and deliver content effectively by breaking down a long lecture to small one to address fatigue and long screen time, group activities for overcoming socializing and anxiety issues, peer interactions on zoom, making the lecture recordings available any time etc.In [6] authors present the advantages of e-learning in the present era. They include the open access to education helps in the increase in independent problem solving capacity and attainment of knowledge. Global knowledge sharing elevates employee skills and quality education reaches the mass. In the developing nations, this provides more opportunities for the growth of educational industries. In [7] authors discuss about future trends in online education. they discuss about micro learning, cloud based learning, gamification to provide better learning experience, adaptive learning to suit the individual needs, usage of augmented reality and AI tools in learning to improve understanding and improve quality of online education.In[8] authors discuss the government policies to help solve the nation's critical education problems, crafting objective analyses and suggesting new ideas for policymakers, educators, and the public at large.In [9] authors along with the advantages of online learning discuss the hardware and software limitations, learning barriers and the quality aspects of online education.

These observations in our literature review related to the preparedness of teachers and students with general issues like smart devices with internet connectivity, socializing and anxiety issues affecting their health are addressed in the survey. The specific issues with respect to content preparation, delivery of the specific types of courses for teachers and understanding these with abrupt transitioning to online learning and negative impacts are discussed in the survey conducted for teachers and students separately.

3. Methodology

Conducted separate surveys to teachers and learners through Google forms after hurried online teaching–learning process was followed during COVID-19 lockdown imposed by the government. The tutors had to develop contents and deliver the contents through different online platforms. The assessment is also conducted online. The challenges both tutors and learners had during this process are discussed in this work. The tutors concentrated on content development, delivery and assessment of different types of courses. Namely 1 Descriptive type 2 Analytical/Research type 3 Numerical type 4 Laboratory with H/W 5 Laboratory with S/W. We conducted surveys for the above discussed issues of ECE and EEE program teaching –learning. We have received a total of 34 responses from tutors and 178 responses from learners. The separate surveys covering the specific issues for teachers and students gave lot of insights for the future of online education. Some factors are common to both the groups and the factors specific to each group are elaborately discussed in this work.

We have categorized the work into 3 parts. The first part deals with the general challenges common to both tutors and students. They are associated with infrastructure, high speed uninterrupted network and connectivity issues, smart devices used for learning, health and concentration related issues.

The second part deals with student challenges associated with learning different types of courses in engineering curriculum. Namely

a) Descriptive/Theory type courses

b) Analytical/Research type courses

c) Numerical courses

d) H/W Laboratory courses

e) S/W Laboratory course

In the third part we concentrate on the issues associated with teachers, pertaining to content development, instruction delivery mode and assessment techniques for the various types of courses mentioned above in the engineering program

a) Analysis of Challenges associated with Content development, delivery and assessment of Descriptive /Theory type courses and experience of teaching

b) Analysis of Challenges associated with Content development, delivery and assessment of Analytical /Research type courses and experience of teaching

c) Analysis of Challenges associated with Content development, delivery and assessment of Numerical type courses and experience of teaching

d) Analysis of Challenges associated with Content development, delivery and assessment of H/W laboratory courses and experience of teaching

e) Analysis of Challenges associated with Content development, delivery and assessment of S/W laboratory courses and experience of teaching

A survey method was used to collect students' opinions on learning using multimedia.[17]. A sample was selected among the students, and they were interviewed privately in a relaxed atmosphere where students did not feel pressured to express their genuine opinions. Interviews among the lecturers were conducted to crosscheck whether the findings gathered in the observations were tallied with lecturers'views on the use of multimedia as a teaching tool.Proportional quota sampling was done for literature students from the first, second and third years with the aim of establishing student opinion on online lectures received.

4. Findings and Discussion

The Survey conducted for Learners of EEE and ECE students

Fig 1 Student/Tutor (a) General Challenges (b) network connectivity experience

4.1 General challenges Associated with infrastructure, network and connectivity issues, smart devices used for learning, health and concentration related issues

Due to infrastructure issues, lack of power supply, poor wi-fi connectivity has affected online learning for majority of the population. [8,9]. The percentage varies from rural to urban areas. The highest rating on a scale of 10, is 22.50% students rated 8. Poorest network connectivity at 10, 9% of the students experienced.

Due to long hours of study the screen time was more which affected the sleeping pattern, neck and shoulder pain, due to lack of physical activity and stress issues as shown in Fig. 2. Around 69% felt the increased screen time caused stress and affected their sleep. Around 60% had chronic neck pain due to over screen concentration. Around 33-34% student population had other issues like obesity, anxiety and other health issues. The zero face-to-face interaction with peer group lead to anxiety. Even online assessments caused anxiety.

This affected the overall health of students. Around 69% of student population felt online education affected their health..

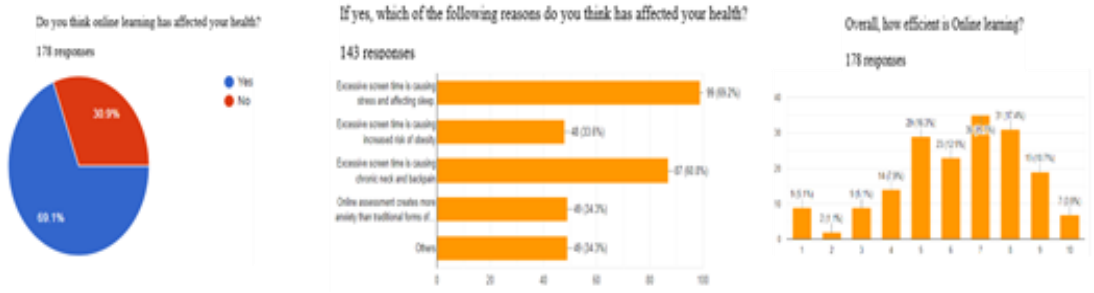

Fig. 2 Impact of OEE on health (a) effect on health (b) reasons (c) overall efficiency

Challenges associated with learning as shown in Fig. 1 (a) and (b) through smart devices, initially when students and teachers did not have smart device/laptop with network connectivity had high rate of dissatisfaction. The maximum around 66.30% had issues with high speed internet required for learning basically the video lectures conducted by teachers were interrupted. As the days continued the sharing of devices and network, became a common understanding and very natural in the household.

When asked their learning experience, haw has been their self-learning experience and their recommendation for future online education as shown in Fig. 3, around 39.90% expressed that there challenges needs to be addressed to make it an enjoyable experience, around 22.50% enjoyed as it is, around 25.80% expressed with few changes they can enjoy learning online.

.If online education is recommended then the most preferred around 35.40% was whiteboard and pen and the second preference by around 29.80% is for digital board. A total of 34% preferred animations and PPT based teaching as shown in Fig. 3.

About 37.50% opined that self-learning is better with online process and 25.60% were neutral on a scale of 5 ranging from strongly disagree to strongly agree. A total of around 25% disagree to this.

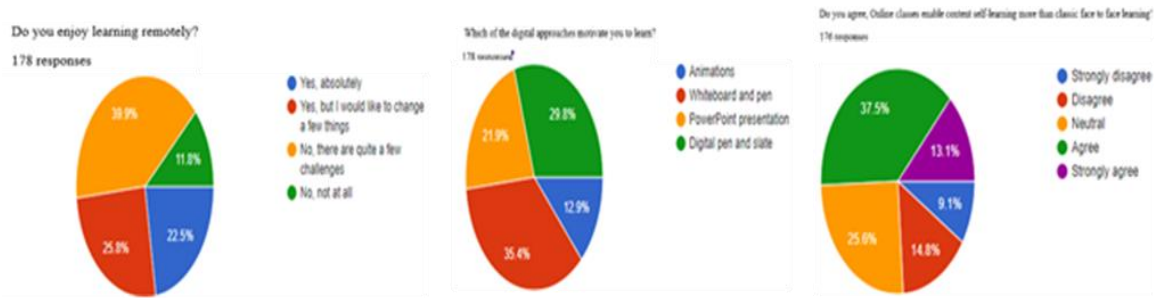

Fig. 3 Student (a) remote learning experience (b) possible digital approaches (c) self- learning experience

4.2 Challenges associated with Learning

The survey questions for students were intended at understanding their issues related to learning the above listed type of courses. The various methods adopted by teachers and their impact on student learning was the key interest so that further improvements can be thought off. The Fig. 4 and Fig. 5 show the preferences and challenges faced by students for the above listed type of courses.

For descriptive courses online sources were referred and 50.60% of students agree that the content was useful and around 34.80% were neutral indicating not too good they felt on a scale of 5 from strongly disagree to strongly agree.

For analytical courses the online learning was challenging for 38.60% of student population rated 4 on a scale of 5 and 30.79% rated 3 and 19.30% rated the highest 5. For analytical courses the learning was challenging for majority population (>50%)

As far as the hardware laboratory circuit realization courses were concerned 65.30% of students were happy to realize using simulators and around 30% preferred together (16.50%+14.50%) the usage of boards and pen. Very few preferred the worksheets. The virtual labs introduced for few lab courses were also well received.

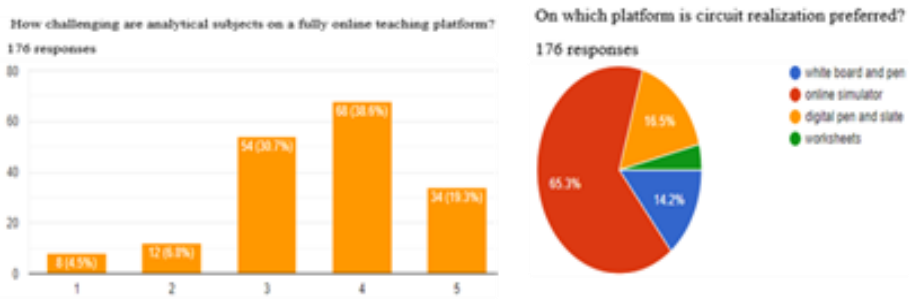

Fig. 4 Student (a) Analytical course learning (b) Analytical circuit realization

The software lab courses did not have many issues once all of them had the required software with the students.

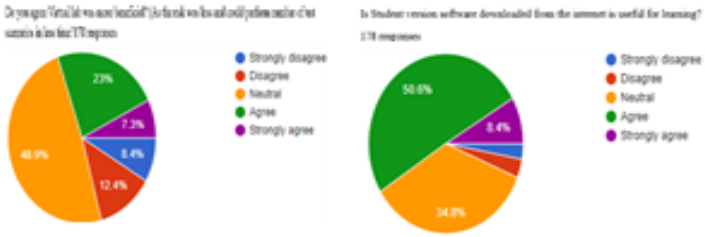

Fig. 5 Student (a) H/W practical experience using virtual lab (b) S/W practical experience

The examination is a very important aspect in any learning, as this is the only way to assess the students for various aspects of learning [10]. For example the knowledge gained, levels of learning attained by each learner, the outcomes attained for a particular course and further modifications to be made for improvements etc. can be successfully assessed by adopting proper assessment methods

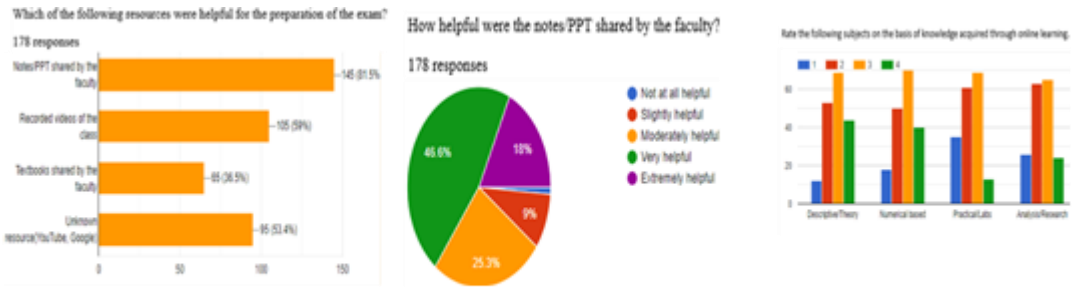

Fig. 6 Assessment related (a)Resourse types (b) Notes/PPTs (c) Comparison of knowledge acquired for different type courses

We tried to find out the overall knowledge acquired for the above listed types of courses on a scale of 4 and observed that the grading was not above 40% for the numerical based/any of the practical courses shown in Fig.

6. Also the rating for descriptive/theoretical courses is also low at around 11%. The highest rating given was at 3 for any type of course as shown in Fig. 7.

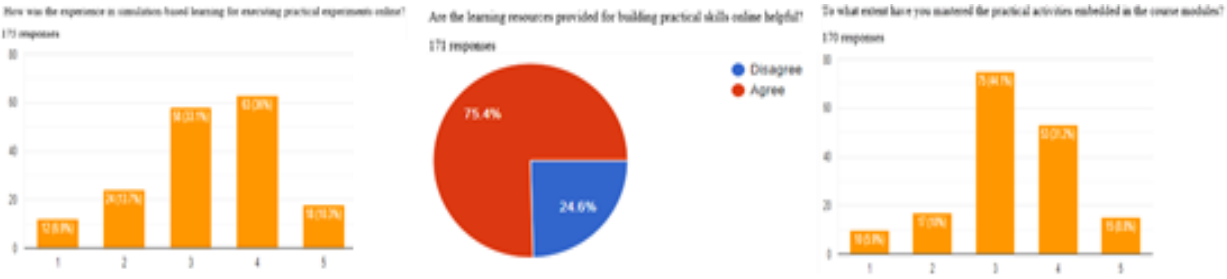

Fig. 7 Practical skill development related (a) Simulation tool usage (b) Online tools(c) Overall practical activity

4.3 The survey results for teachers are discussed in this part of the work.

Surveys conducted for Teachers and the survey questions were aimed at collecting data from general issues to specific issues which dealt with content development, delivery and assessment related issues of teachers. As the teachers had to develop and deliver contents in fully online mode for various types of courses without any training for special skills required for this [11,12]. The engineering education involves studying theoretical courses, descriptive, analytical and research oriented courses for overall engineering knowledge building purpose. Apart from these concept building courses, the practical knowledge is developed through hardware and software laboratory courses. During the pandemic these laboratory courses were managed with the help of simulation tools. To understand the challenges of the teachers the questionnaire is divided into 5 sections namely the challenges faced for descriptive, analytical/research, numerical and both hardware and software laboratory course development, delivery and assessment related issues.

4.3.1Result analysis of Descriptive type of courses

In this we have considered the issues of tutors in developing the contents, tools and techniques used for delivering the descriptive or theoretical content and the assessment techniques adopted for the same. The data is collected for the challenges encountered and their overall experience during the process.

i) The survey results associated with content development, challenges and overall experience are shown in Fig. 8 The majority of teachers (94%) preferred to use PPT with more description for content development over readily available audio and video contents.Overall experience of teachers scaled at a highest 52% rated 4 on a scale of 5indicated not very happy with it

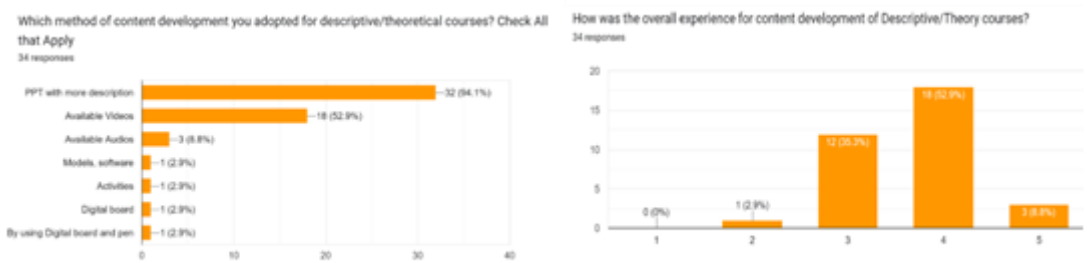

Fig. 8 Content development of Descriptive/Theory type (a) Method adopted(b) Overall experience

ii) The content delivery of descriptive /theory courses the results are given in Fig. 9.During instruction delivery we had asked the most preferred method for content delivery and 97% of teachers first preference was through PPTs and the next method was through digital boards which was around 58.80% and third preference around 10% opted for audio and video contents available on the internet. During instruction/content delivery

82.42% of teachers found limited interaction with students was a primary challenge over holding attention of students which was around 67.60%.The overall experience on a scale of 5 from poor to excellent 67.70% rated Good and 17.60% rated very good , 11.80% rated fair and only 2% excellent

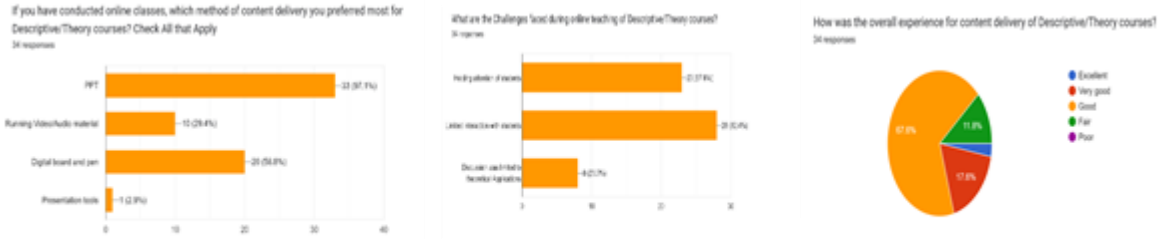

Fig. 9 Content delivery of Descriptive/Theory (a) Method adopted (b) Challenges(c) Overall experience

iii) The assessment related information is given in Fig. 10.The assessment was done in multiple ways. The widely used styles were MCQ, descriptive and objective questions. Few have combined all three types of questions. In all 76.50% teachers used MCQ techniques to minimize malpractices with shuffling of questions, 52.90% teachers used descriptive questions and 44% used objective questions.The majority 73.50% found it challenging as proctoring was not easy, around 23.50% found no difference in comparison with regular examination. The overall experience of assessment was good for 73.50% and 11.80% each very good and fair and nobody had excellent experience on a scale of 5 ranging from poor to excellent.

Fig. 10 Assessment of Descriptive/Theory (a) Method (b) Challenges (c) Overall experience

4.3.2 Result analysis of Analytic/Research type courses

In this we have considered the issues of tutors in developing the contents, tools and techniques used for delivering the Analytic/Research type content and the assessment techniques adopted for the same. The data collected for the challenges encountered and their overall experience during the process are discussed in this section.

i)) The survey results of Content development issues are shown in Fig. 11.The most preferred style of content development was PPTs with solved examples around 94%, for better understanding of analytical questions and analysis research based topics.. Only 8.8% preferred recorded videos. The challenges faced during the development was including more solved examples in PPTs and the overall experience of content development of this type of course is at level 3 a maximum of 55.90% and 29.40% at level 4 on a scale of 5.Nobody experiencedhighest level of contentment of 5.

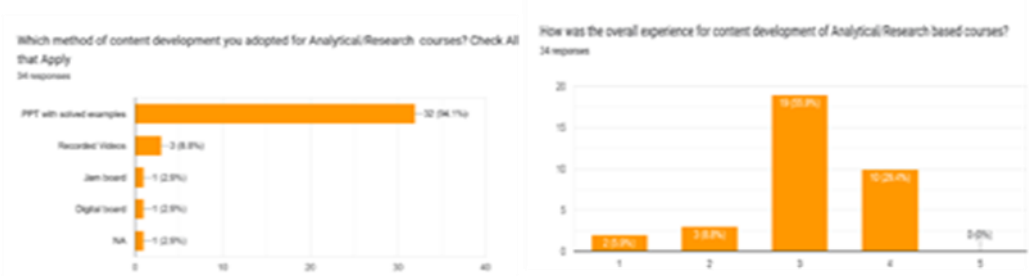

Fig. 11 Content development Analytic/Research (a) Method(b) Overall experience

ii)The Content delivery issues and results are given in Fig. 12.The content delivery techniques preferred most were software tools/simulators by 67.60% and digital pen and slate were preferred by 47.00% as second choice flipped classes and flowchart ,signal flow graphs were preferred least. The challenges faced during content delivery were limited interaction with students around 76.50% felt this, solving numerical for 64.70% were challenging and 61.80% found holding attention was challenging.The overall experience of 55.90% faculty felt good, 32.40% felt fair and 11.80% felt very good. Nobody remarked neither excellent or poor.

Fig. 12 Content delivery of Analytic/Research (a) Method(b) Challeges (c) Overall experience

iii) Results of assessment of analytic/research type courses is explained Fig. 13.The assessment was done in multiple ways. The widely used styles were MCQ, descriptive and objective questions. Few have combined all three types of questions. In all 76.50% teachers used MCQ techniques to minimize malpractices with shuffling of questions, 52.90% teachers used descriptive questions and 44% used objective questions. The majority of teachers 70.60% felt that there is limited scope for analytical question –answers and also 61.80% felt only MCQ/quizzes cannot provide sufficient scope to assess the students. The overall experience of assessment was good for 61.80% and 17.60% very good and 11.80% fair and 8.80% poor, nobody had excellent experience on a scale of 5 ranging from poor to excellent

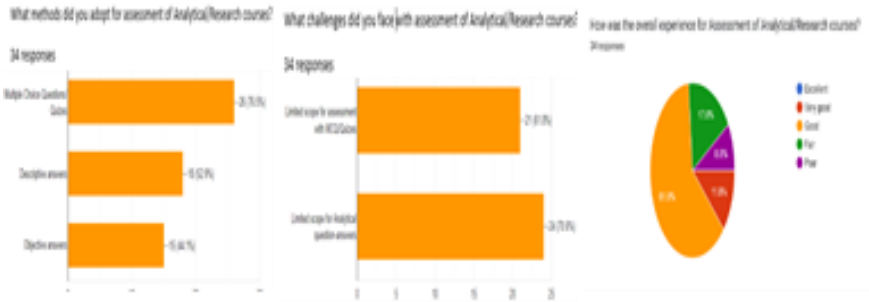

Fig. 13 Assessment of Analytic/Research courses (a) Method)(b) Challenges (c) Overall experience

4.3.3 Results and analysis of Numerical type courses

i)The content development is shown in Fig. 14.The most preferred style of content development was software tools, around 70.60%, the second preferred was recorded videos at 52.90% and the third preferred style was online software at 32.40% .The challenges faced during the development was including more solved examples in PPTs and the overall experience of content development of this type of course is at level 3 a maximum of 44.10%% and 32.40% at level 4 on a scale of 5.Only 5.90% experienced highest level of contentment of 5

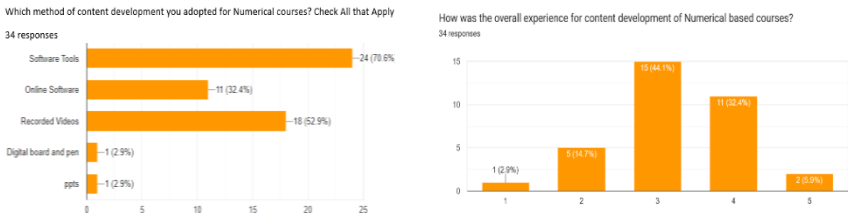

Fig. **14 Content development of Numerical (a) Method (b) Overall experience**

ii) The content delivery related results for Numerical type course are shown in Fig. 15. The content delivery techniques preferred most were digital pen and slate at 73.50%,the second choice was explaining solved examples through PPTs at 70.60%. and shared video material was preferred least at17.60%.The challenges faced during content delivery were limited interaction with students around 76.50% felt this, solving numerical for 64.70% were challenging and 61.80% found holding attention was challenging.The overall experience of 50.00% faculty felt good, 20.60% felt very good, 17.80% felt fair and 8.8% felt poor and negligible percentage remarked excellent

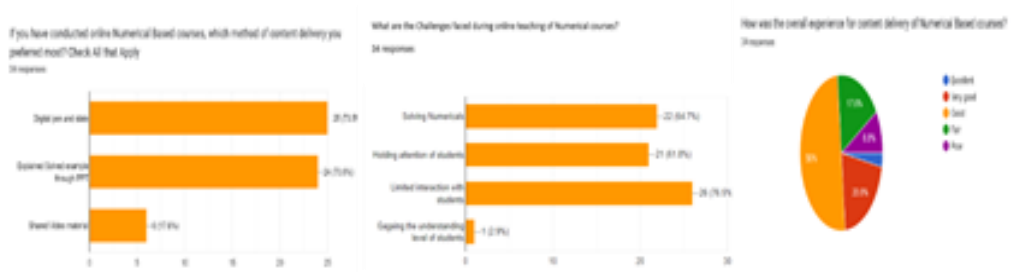

Fig. 15 Conent delivery of Numerical type (a) Method(b) Challenges (c) Overall experience

ii) The assessment related results are shown in Fig. 16.The assessment was done in multiple ways. The widely used styles were MCQ, descriptive and objective questions. Few have combined all three types of questions. In all 76.50% teachers used MCQ techniques to minimize malpractices with shuffling of questions, 52.90% teachers used descriptive questions and 44% used objective questions. The majority of teachers 70.60% felt that there is limited scope for analytical question –answers and also 61.80% felt only MCQ/quizzes cannot provide sufficient scope to assess the students. . The overall experience of assessment was good for 52.90% and 17.60% very good and 20.60% fair and 8.80% poor, nobody had no excellent experience on a scale of 5 ranging from poor to excellent

Fig. 16 Assessment(a) Method (b) Challenges (c) Overall experience

4.3.4 Result analysis of H/W Practical courses

i) The results for h/w practical course content development are shown in Fig. 17

The most preferred style of content development was simulation tools, around 70.60%, the second preferred was

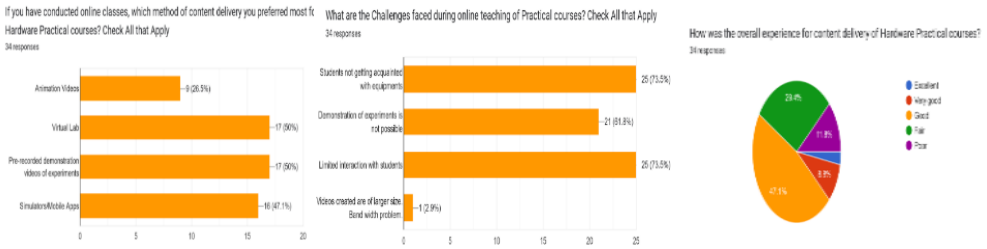

Fig. **18 Content delivery of H/W courses (a)Method(b) Challenges (c) Overall experience**

demonstration videos at 52.90% and the third preferred style was virtual lab 44.10% .

ii)The content delivery or conduction of H/W practical courses online related results are discussed in Fig. 18.

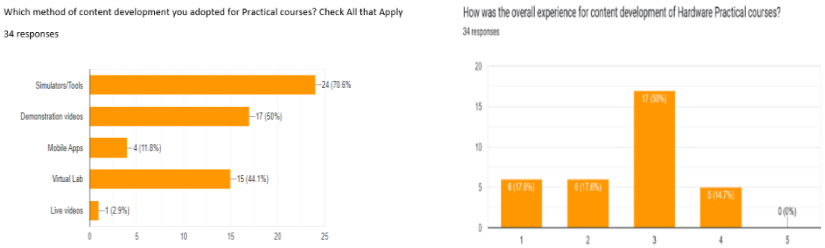

Fig. **17 Content development H/W courses (a) Method (b) Overall experience**

The content delivery most preferred were virtual labs and pre-recorded videos of experiments around 50% each and then the simulation apps were preferred by 47 % and lastly animation videos about 26%.About 73.50% teachers expressed limited interaction with students and not getting to experiment on equipments were the biggest challenges. About 61.80% expressed unhappiness over not getting to demonstrate on hardware was a challenge. Majority about 47% felt good , 23% felt fair least percentage felt excellent on a scale of 5 ranging from poor to excellent

iii)The content assessment of practical courses is shown in Fig. 19.The assessment primarily 67.60% was conducted through quizzes, about 44% each through objective questions and simulation tools.The assessment through actual conduction of experiments was not happening. Around 67.60% expressed concern over this. Around 26.50% each expressed there is limited scope to evaluate through simulators and mobile apps.

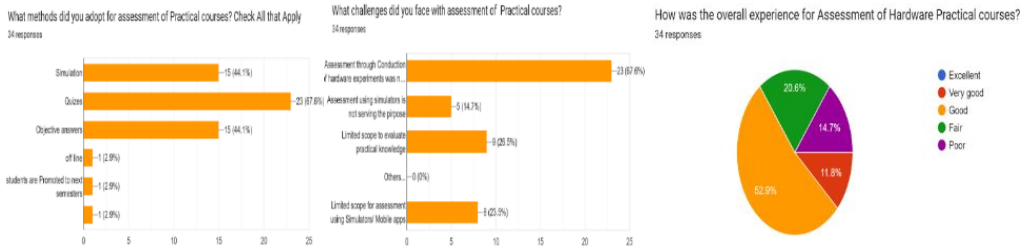

Fig. **19 Assessment of H/W courses (a) Method(b) Challenges (c) Overall experience**

4.3.5 *Result analysis of S/W practical. Courses.*

i)The results of content development of S/W courses is given in Fig. 20.For all software labs the content development was don with simulation tools by 70% and 50% adopted demonstration videos and 44% used

virtual labs. The overall experience was rated 3 by 47.50% and 44% rated 4 and nobody rated 5 on scale of 5.

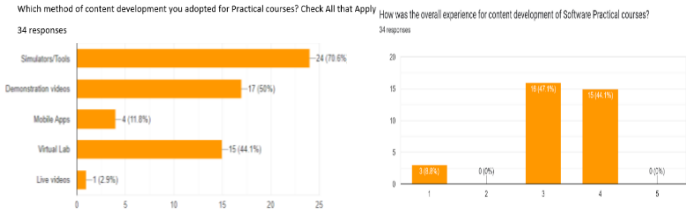

Fig. **20 Content development of S/W courses (a) Method(b) Challenges(c) Overall experience**

ii)The content delivery S/W courses

The popularly usesd method was through simulators(61.60%) and online coding platforms(52.90%). Flipped classes were least preferred options (20.60%). Around 58^0% felt good about conduction 23.50% felt fair and

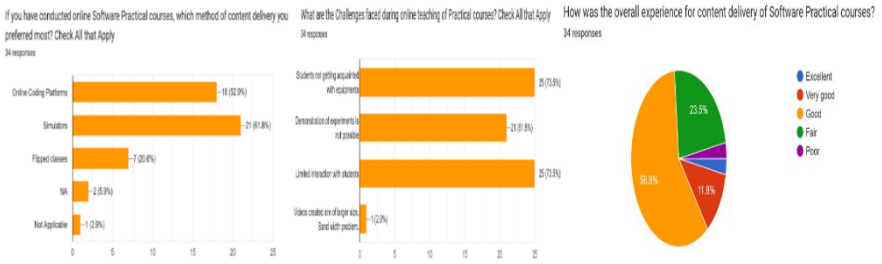

*Fig.***21 Content delivery S/W courses (a) Method (b) challenges (c) Overall experience**

11.80% felt fair as shown in Fig. 21.

iii)The assessment of S/W courses-

The assessment The assessment primarily 67.60% was conducted through quizzes, about 44% each through objective questions and simulation tools. The assessment through actual conduction of experiments was not happening. Around 67.60% expressed concern over this. Around 26.50% each expressed there is limited scope to evaluate through simulators and mobile apps. The overall experience for 61.80% was good 17.60% felt fair and 8.8% expresses very good on a scale of 5 ranging from poor to excellent as shown in Fig. 22.

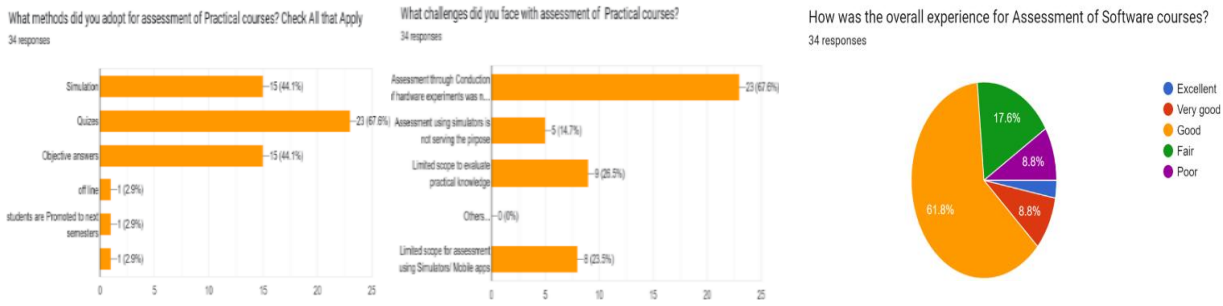

Fig. **22 Assessment of S/W courses (a) Method (b) Challenges (c) Overall experience**

5. Conclusions and Future scope

This study is aimed at identifying factors which have impact on online teaching–learning process. The survey questions are concentrated on finding out the experience of teachers and students, for various types of circuital branch engineering courses and factors associated with teaching, learning and assessment of descriptive/theoretical, Analytical/research, numerical, H/W and S/W practical courses during lockdown.

The most common factors for both students and teachers were the smart devices without back up facility, for long hour usage, non-availability of high speed internet. Due to these issues majority student's online

learning experience was not good. Also long hours of screen time, anxiety for online submission of assignments as interaction with peer group was missing. This and zero physical activities lead to health issues. As far as learning related factors of students are concerned self-learning component improved, the descriptive courses were well received, analytical/research, numerical courses were challenging and learning through only PPTS alone doesnot fulfil the needs of acquiring knowledge at higher levels. The simulation tools, virtual labs for practical courses were enhancing the knowledge. The overall experience with existing style was not very satisfactory.

As far as teaching is concerned the content development and instruction delivery was majorly done using PPT for descriptive/analytical/numerical type courses. Engaging students actively was challenging. Both students and teacher did not have excellent experience. The Hardware laboratory courses where conducted using simulation tools, virtual lab. The teaching community opined that better ways to be learnt or blended mode is preferred. The assessment was done through MCQ/objective questions/quizzes. The teaching community opined that limited scope for assessment through this. Also proctored exams, shuffling of questions was done to grade students fairly. Practical course assessment was not satisfactory for H/W courses and S/W courses online tools were quite satisfactory. Both stake holders are interested in continuing the OEE by incorporating modifications with the already conducted methods. The long screen hours can be minimized by flipped classes, restructuring the contents with more activity based, project based learning so that peer interaction is encouraged and anxiety and long screen hours can be minimized, also presentation of activities/miniprojects improves interaction with teachers and peer groups.

Teaching community can incorporate Augmented and Virtual reality (AR/VR) based teaching, more industry relevant simulation tool based teaching for analytical/research type courses. Continuous Assessment can be regularized which encourages student engagement and active learning. Other assessment techniques like quizzes/MCQ/objective type can be combined with project based assessments, case studies and their presentations so that scope for assessment increases.

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