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THE IMPLEMENTATION OF ONLINE PRACTICUM CLASSES DURING THE COVID-19 PANDEMIC AT SAMPOERNA UNIVERSITY

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ABSTRACT

The unprecedented Covid-19 pandemic has altered how educational institutions operate, including Sampoerna University. Distanced learning has been commonly implemented since then. Not only for taught classes but laboratories or practical activities, such as Mechanics of Materials and Machine Shop, have also been organized virtually for the undergraduate student in the mechanical engineering study program. Two activities were carried out during the conduct, namely the (1) preparatory stage, where all the teaching materials in the form of videos were prepared, and (2) virtual lab. At the end of the semester, the participating students were asked to fill out a questionnaire to evaluate the entire practicum process. The results revealed that, according to students, teaching and learning activities performed in such a way are quite effective and satisfying. Regardless, based on the survey result, the students expect to have practical activities conducted in person to gain hands-on experience.

Keywords Mechanical Engineering; Distanced learning; Laboratories; Practical Activities.
Paper type Research paper

INTRODUCTION

The rapid spread of Corona Virus Disease-19 (Covid-19) has turned into a global pandemic, as declared by the World Health Organization in 2020. This situation has prompted global leaders to make various efforts to stop the transmission of the virus. One is limiting public activities such as mass gatherings or physical interactions. The Indonesian government also took this effort as one of their concerns by introducing the *Social Distancing* regulation, which requires every individual to limit outdoor activities and social interactions. This led to a major change in many daily activities. Working and studying, to name a few were since then carried out remotely.

Therefore, working and studying from home have encouraged respective institutions to adapt in any way possible while not compromising the output quality. Particularly for higher educational institutions, such as universities, the delivery of theoretical learning can be done utilizing various common media and software like Microsoft Teams or Zoom Meetings. Unlikely, several courses, such as those with laboratories courses, require practical activities, which then demand the presence of innovative solutions.

According to Nurhalimah et al. [1], laboratory practice is a learning process that provides opportunities for students to integrate and apply theories to real settings by practicing skill improvement as the application of knowledge learned independently or in groups to achieve learning objectives. The virtual or online laboratory is an alternative learning environment that can help students overcome limited access to laboratory facilities [2]. Based on a study by Saraswati and Mertayasa [3], conducting virtual laboratories are relatively easier and cheaper than the conventional method and also can reach more people in many places. Similarly, as Aljuhani et al. [4] expressed, virtual laboratories offer ease for the users as the learning activities can be performed beyond the classroom.

As stated by Nursalam and Efendi [5], media and teaching tools greatly affect learning activities as they are tools to transfer information that can be seen, heard, and understood by students. Gunawan et al. [6] define the virtual laboratory model as an interactive multimedia object comprising various formats, including text, hypertext, sound, images, animation, video, and graphics. On the other hand, according to Arsyad [7], virtual laboratories are not necessarily a substitute for conventional

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laboratories for students but instead an alternative to understanding the concept to understand the materials more easily.

Mechanics of Materials Laboratory and Manufacturing Process for Laboratory (Machine Shop) courses is among several practical classes or laboratory courses in the Mechanical Engineering study program at Sampoerna University. The Mechanics of Material laboratory course aims to introduce students to the strength and characteristics of materials and provide hands-on experience in operating material testing equipment. In contrast, the Machine Shop laboratory course gives hands-on experience to students to understand the manufacturing process. Since Sampoerna University is located in Jakarta, the institution must follow the regulation prescribed by the Provincial Government of Jakarta, which is social distancing in teaching and learning activities. As an implication, the laboratory mentioned above course activities must be conducted virtually.

This paper aims to explain and explore implementing virtually / online practicum classes, i.e., Mechanics of Materials and Machine Shop lab courses in the Mechanical Engineering study program at Sampoerna University, and to evaluate the results based on the students' responses.

METHOD

During the COVID-19 pandemic, Mechanics of Materials and Machine Shop laboratory courses at Sampoerna University were performed virtually for four months from August to December 2020, the Fall Semester of 2020/2021. There were six modules in the Mechanics of Materials lab course, namely: (1) tensile test, (2) hardness test, (3) Charpy impact test, (4) bending test, (5) I-beam bending test, and (6) steel quenching. The Machine Shop lab course also carried out six modules, which are: (1) 3D printing manufacturing process, (2) Lathe, (3) Milling, (4) CNC Lathe, (5) CNC milling, and (6) virtual welding. The method section here is divided into two, discussing the preparation and implementation of the virtual laboratory.

Preparatory Stage

The preparatory stage focuses on developing learning materials, such as practicum videos and script writing in this context. Time allocation, narration to be delivered (voice-over), layout plan, and preparation of tools and equipment were conducted before the tapping. Lighting setting was also considered well as it is valued as important to be able to record appropriate image quality (Figure 1).

Figure 1. Lighting setting for virtual lab video recording

Next, the specimen was prepared, and preliminary testing was performed. The preliminary testing was considered important to minimize the risk of failure during the test and to anticipate errors in the video recording process. Figure 2 shows the preparation steps for the Mechanics of Materials and Machine Shops Laboratory.

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(a) (b)

Figure 2. (a) Impact test specimen preparation for Mechanics of Materials Laboratory, 2(b) Tools preparation for Machine Shops Laboratory

Afterward, the recording process was performed, as shown in figure 3. This is the most important part of conducting the virtual lab.

Figure 3. Video recording process

Figure 4. The narration recording process for the Mechanics of Materials Laboratory

Figure 4 shows the narration recording process. The narration explaining the steps of the experimental procedure according to the module is included in the video.

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Figure 5. Video editing process using Camtasia 2020

After the narration recording was completed, the video was edited using Camtasia 2020 software (Figure 5). The editing was purposely conducted to synchronize the recorded video and the narration; therefore, the students can follow the experiment properly according to the module. Some additional features were added, such as running text and transitions.

The edited video was then uploaded to YouTube. The following links are the access to the Mechanics of Material and Machine Shop lab courses, respectively https://youtu.be/ZM3QyJRSJ_w https://youtu.be/V5bJW_pyMoc.

Implementation Stage

The Mechanics of Material Lab class was scheduled on Monday (02:30-05:30 PM), while the Machine Shop lab class was scheduled every Friday (02:00-05:00 PM), involving 17 and 13 students, respectively. Both classes were held virtually using Microsoft Teams software. Figure 6 shows some captions taken during virtual class activities.

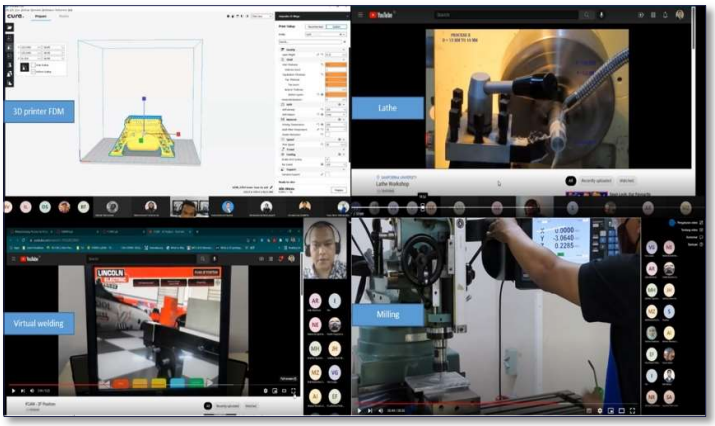

Figure 6. Some captions during virtual lab class activities

In general, the two courses' laboratory activities were conducted in the following way:

1. Joint discussion, where students were divided into four groups for the Mechanics of Material lab class and three groups for the Machine Shop lab class, consisting of 4 to 5 students per group. This 60-minute session was dedicated to the students to discuss the basic theory of each module.
2. Presentation and question and answer (Q&A), where the students presented the results of their group discussion to the lecturers and lab instructors for 10 minutes, followed by a 5-minute Q&A.
3. According to the scheduled module, the video was played for 40 to 90 minutes.

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4. After watching the video, the experiment data was sent over to students as supporting materials for them to write a report within two weeks.

RESULT AND DISCUSSION

The result and discussion are divided into two sections based on the course to observe each course individually.

Mechanics of Materials Lab Course

After four months of the class period (August-December 2020, Fall Semester of 2020/2021), students were asked to fill out a questionnaire that had been prepared in advance. The questionnaire focused on evaluating teaching and learning activities during the implementation time.

TABLE I. QUESTIONNAIRE RESULTS ON THE IMPLEMENTATION OF VIRTUAL MECHANICS OF MATERIALS LAB COURSE

No.	Aspects	Average Score (Maximum 5)
1	Instructors understand the needs and challenges of practicum students	4,27
2	Instructors use English at every meeting/practicum	4,18
3	Instructors use a variety of strategies (discussion groups, case studies, experiments, etc.) to teach each class	4,09
4	Instructors seek to connect theory with field practice (application).	4,55
5	The instructor speaks clearly, and the voice level (not monotonous) in communicating during the class	4,27
6	Instructors are very dynamic and enthusiastic in delivering the material taught	4,45
7	Instructors can engage all students in the classroom using a variety of teaching strategies	4,09
8	Instructors provide clear instructions on the concepts taught	4,36
9	Instructor encourage and facilitate student participation through activities, Q&A and discussions	4,45
10	Students are encouraged to express their ideas based on the lecturer's questions.	4,36
11	Instructors help students to develop higher-order thinking skills (e.g. Critical Thinking, Problem Solving, Creativity, Emotional Intelligence, etc.) through these classes.	4,27
12	The instructor encourages and motivates all students to take the initiative to study on their own.	4,55
13	Instructors use Information and Communication Technology (ICT) effectively to improve lessons.	4,45

Table 1 presents the student satisfaction results in participating in the virtual lab activities. With an average score of 4 out of 5, this simply shows that the participants are quite satisfied with the methods and strategies designed by the instructors in carrying out the teaching and learning process.

For aspect number 3, on the variety of strategies used to teach the class, an average score of 4.09 is achieved. This follows the method applied during the lab session, where the class consists of a discussion, presentation, question & answer (Q&A), and report writing.

Aspect number 11, “Instructors help students to develop higher-order thinking skills (e.g. Critical Thinking, Problem Solving, Creativity, Emotional Intelligence, etc.) through these classes”, achieved an average score of 4.27. This is about aspect number 3, where the participating students were asked to engage in discussion, presentation, and Q&A sessions actively, thus encouraging students to think critically. In line with Nugroho [8], it is said that a well-organized learning flow promotes active learning objects for students.

With an average score of 4 out of 5, this concludes that implementing the Mechanics of Materials lab course using the virtual method is considered *good*. However, as summarized in Table 2, an average score of below four is obtained for “Students' mastery of concepts and skills in the mechanics of a materials practicum class. However, this value is very reasonable, given the desire

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for participating students to have hands-on experience operating the mechanical testing machine and equipment, as stated by students when filling out the questionnaire. Details of students' reasons are listed in Table 3.

TABLE 2. STUDENT SATISFACTION

No.	Aspects	Average Score (Maximum 5)
1	The overall quality of the practicum class mechanic of materials	4,18
2	The overall effectiveness of the lecture (Instructor)	4,09
3	Studen mastery of concepts and skills in the mechanic of a materials practicum class	3,82
4	Enjoying an engineering material practicum class	3,82

TABLE 3. STUDENTS' REASON

No.	Question	Student Answers
1	What do you dislike about the online practicum?	Unable to do practicums in the laboratory
2		The thing I dislike most about this course is that the practicum is done online. Therefore, we can not experience it firsthand, making it more difficult to understand the process.
3		I can't try the machine immediately because it's the covid-19 pandemic.
4		I want to use the tools and equipment.

Their unfamiliarity drives the students' desire to have an in-person session with the implementation of virtual lab classes. As explained in the literature, the implementation of virtual lab classes focuses on mastering the concept and the ability of individuals to think creatively and independently [9]. Meanwhile, conventional lab sessions can encourage the students to be active and creative in experimenting with objects utilizing laboratory facilities [10]. Therefore the questionnaire results from this course follow the literature.

Machine Shop Lab Course

Several aspects were considered to get information on how effective online teaching in the Machine Shop lab class was conducted during the COVID-19 pandemic, which are (1) assessment results and feedback, (2) professionalism of the instructor, (3) teaching and learning process, and (4) students satisfaction.

As shown in Table 4, the category of assessment and feedback receives a fairly high level of satisfaction, an average of 4.6/5. From this result, it is safe to say that students feel that the lecturer provided them opportunities and support they needed to stay active in participating in the class. This is reflected in the routine activities carried out during the online classes, where the lecturer always allocated time for students to ask questions and discuss. According to Table 5, students were satisfied with the class conduct in terms of the professionalism of the instructor. The student's satisfaction with the teaching and learning process is high, as indicated in Table 6, where an average of 4.7 from the maximum score of 5 is achieved.

Table 7 shows the overall students' satisfaction. An average of 4.35 out of 5 is achieved, showing a good acceptance of the students. Regardless, this virtual lab method is also inseparable from comments and inputs from the students. To summarize, similar to the Mechanics of Materials lab course, students in the Machine Shop lab course were also expected to have an in-person session. According to students, although the theory of manufacturing processes is well delivered, the skill of operating the machine is the main goal, and it cannot be achieved through only conducting virtual lab activities.

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TABLE 4. STUDENTS SATISFACTION WITH ASSESSMENT RESULTS AND FEEDBACK

No	Aspects	Score (Maximum 5)
1	The instructor gave good and timely feedback for the assignments I submitted.	4.3
2	The instructor made it easy for me to contact him for help if I needed help with assignments.	4.7
3	The assignment assignments and requirements (rubrics) are clearly explained to me throughout the course.	4.7
4	Instructors consistently conduct assessments (formative/on-going) to check if we understand the content being taught.	4.7
5	They are a sufficient number of tasks and exams/exams.	4.5
6	The evaluation method is fair and appropriate.	4.6

TABLE 5. STUDENTS SATISFACTION WITH THE PROFESSIONALISM OF THE INSTRUCTOR

No	Aspects	Score (Maximum 5)
1	The instructor was punctual for most of the class.	4.9
2	I was notified in advance (two days) if classes were rescheduled.	4.9
3	Instructors show concern and concern for students.	4.7
4	Instructors communicate warmth and respect to students.	4.7
5	Instructors pay attention to student progress.	4.4
6	Instructors respond to my online emails/inquiries usually within two days.	4.9

TABLE 6. STUDENTS SATISFACTION WITH THE TEACHING AND LEARNING PROCESS

No	Aspects	Score (Maximum 5)
1	Instructors understand students' needs and challenges	4.6
2	Instructors use a variety of strategies to teach courses (e.g. teaching, group work, discussions, thought experiments, case studies, hands-on activities, etc.)	4.6
3	Instructors make efforts to make real-world connections/applications with the topic being taught	4.8
4	The instructor speaks and with varying voice levels (not monotonous) in communicating the lesson.	4.5
5	Instructors encourage and facilitate student participation through activities, questions and discussions.	4.8
6	Students are encouraged to express their ideas and/or question the instructor.	4.8
7	The instructor helped me develop Higher Order Thinking Skills (e.g. Critical Thinking, Problem Solving, Creativity, Emotional Quotient, etc.)	4.8
8	The instructor encourages and motivates all students to take the initiative to learn independently.	4.7

TABLE 7. OVERALL STUDENT SATISFACTION ON VIRTUAL LAB CONDUCT

No	Aspects	Score (Maximum 5)
1	The overall quality of this course is	4.4
2	The overall effectiveness of lecturers and instructors	4.5
3	My mastery of the concepts and skills in this course	4.2
4	I enjoyed the course	4.3

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CONCLUSION

The COVID-19 pandemic has resulted in challenges in organizing teaching and learning activities, especially experimental work and lab courses. The strict health protocols thus promote remote learning activities that have been widely implemented worldwide since 2020, with no exception for Mechanics of Materials and Machine Shop lab courses in the Mechanical Engineering Study Program at Sampoerna University. This situation encouraged innovation in conducting the lab session; hence the knowledge transfer continues to run well. After four months of virtual lab conduct, a questionnaire on the overall teaching and learning activities was distributed to the participating students of the Mechanics of Materials lab course. An average score of 4 out of 5 indicated an effective lab session. The questionnaire to evaluate student satisfaction was also given to students in the Machine Shop lab course. The survey revealed that student satisfaction with the teaching and learning process gained 4.7 on average and overall satisfaction with virtual conduct was 4.35. Several comments, inputs, and suggestions were also well noted, mostly related to the student's desire to have an in-person session for both Mechanics of Materials and Machine Shop lab courses to get hands-on experience. It is understood that the virtual lab may not be the ideal learning method. According to the participants' survey, the kind of learning system is considered adequate during the pandemic despite all the shortcomings. Therefore, the challenge remains how to create such a learning method where the students' interests and needs can be best accommodated.

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