Students Perception Towards the Implementation of Asynchronous Video Lectures and Video-based Instructions in Experimental Fluid Mechanics Course

Mohd Rusdy Yaacob
Faculty of Electrical Engineering, Universiti Teknikal Malaysia Melaka

Clara Marika Velte
Department of Mechanical Engineering, Technical University of Denmark

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Students Perception Towards the Implementation of Asynchronous Video Lectures and Video-based Instructions in Experimental Fluid Mechanics Course

Mohd Rusdy Yaacob[1,*], Clara Marika Velte[2]

[1]Faculty of Electrical Engineering, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

[2]Department of Mechanical Engineering, Technical University of Denmark, Nils Koppels Alle, Building 403, 2800 Kgs. Lyngby, Denmark

*Author to whom correspondence should be addressed:
E-mail: rusdy@utem.edu.my

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Abstract: Computer-based approaches have recently become a fully viable alternative to classical lectures as a consequence of the global pandemic. In the Experimental Fluid Mechanics course at the Technical University of Denmark, a blended approach of video-based lectures and instructions and experimental work has been adopted. Students' feedback on this implementation have been collected through a series of questionnaires. The evaluation results reveal that both video-based lectures and video-based instructions are beneficial and should be fully adopted for the rest of the experiments.

Keywords: video-based lecture; asynchronous teaching; video-based instruction; experimental work; blended learning;

1. Introduction

Recently, face-to-face (F2F) learning[1)] has become much less favorable when most of the academic institutions were urged to transform their teaching and learning to computer-based learning due to the global COVID-19[2)3)] outbreak. Since then, technology adoption has been part of the new paradigm of education, which includes online learning[4)5)].

Online learning can be implemented either synchronously or asynchronously[6)]. The former takes place in real time while the latter's content is made available online for students to access during their free time. This study focused on Experimental Fluid Mechanics course that that was taught using asynchronous video lectures for a group of MSc in Mechanical Engineering students. This course has been offered for more than 30 years[8)] during which F2F lecture has been in place (except for the Signal Processing topic). This also includes during the time when the course was part of the International Turbulence Masters Programme at the Chalmers University of Technology[9)10)].

The reason for the asynchronous online learning is due to the existence of finite number of setups for each different experiment, urging students to execute all the assigned experiments in random order. With asynchronous learning, students got the chance to undergo an autonomous learning by having the autonomy to decide the best learning approach for them in order to progress through the course. The asynchronous learning is a practice that can benefit the students either to acquire knowledge while carrying out the experiments or just before. Another benefit is the opportunity for the students to repeat the lectures after application to further strengthen the learning process[7)].

Just after the winter semester of 2018's edition[11)], the course instructors cum the authors of this paper decided to opt for asynchronous video-based lectures for more topics, with the aim to save more contact hours for higher level interactions, e.g., Q&A session with the students during the F2F meeting. Three important topics were chosen for this new approach, i.e., Laser Doppler Anemometry, Particles Image Velocimetry and Signal Processing. Thus, this action research is on the students' perception towards the asynchronous video lectures.

Besides a series of lectures encompassing the theoretical knowledge of Fluid Mechanics, this course is also embedded with a series of experimental works that embodies experiential learning[7)] and problem solving as the powerful tools in teaching and learning. For more than 30 years this course was first annually offered[9)], demonstration for the experimental works has been

conventionally conducted in physical forms with step-by-step demonstration as to ensure the students can operate the experimental setups and perform experiments[12]. With this approach, the course instructors had to spend more time as they needed to repeat the same demonstration to each different group of students who used a particular setup in rotational basis due to limited access to the setup itself[13]. This approach has refrained the course instructors from efficiently spending their contact hours in the laboratory for a higher level interaction and discussions with the students.

Besides introducing video-based lectures during the last Winter Semester 2020, the authors have also introduced video-based instructions for the experimental works[14] into the Experimental Fluid Mechanics course, with an aim of making the course modular and thereby flexible for students and teachers alike. With less effort, any student can therefore be instructed to conduct the experiment. Out of the five experiments listed for this course, the video-based instructions were provided for one experiment only as a beginning, that is Particle Image Velocimetry (PIV) in a Water Tunnel.

2. Implementation

2.1 Video-based lectures

Three weeks prior to the official start of the lecture, students were required to enroll into the course through DTU Inside, which is the university official web portal that contains all the relevant teaching materials uploaded by the course instructors. The materials include a written work plan prepared by the instructor in charged for a certain topic, e.g., Signal Processing. The work plan comprises the YouTube link for the video-based lectures, descriptions on the introduction of the topic, instructional descriptions on the respective exercises and directories to the respective quizzes for each sub-topic. Instead of compiling everything into one long video for one particular topic, a curated list of short video-based lectures corresponding to each sub-topic were recorded and uploaded in YouTube. The videos were filmed using the slide cast with audio recording built into PowerPoint.

With this approach, the students demonstrated deep understanding when they immediately implemented what they learnt from the video-based lectures onto the exercises. At the same time, they could easily revisit specific lessons anytime when needed. Since the topic is particularly complex, the students learned much better by this continual application of their knowledge instead of having a 4-hour lecture on the topic before applying what they had learned. Students' memory retention in following the video-based lecture has also been enhanced when using this approach[14].

The lectures were delivered by three different instructors having individual expertise on specific topics, adopting the team-teaching strategy. The course was still conducted based on a fixed timetable throughout the three weeks as in the previous editions. Students were given the freedom to study the video-based lectures wherever convenient while some lectures required mandatory presence, thus adopting the blended learning approach. For the purpose of having further discussions related to the topics and exercises, one of the instructors was physically present in the classroom. The other two instructors were still reachable through phone and email to cater for unanswered questions by the course instructor on duty. For offline reference in the future, conventional lecture notes were also still made available at the students' request.

2.2 Video-based experiment instructions

Similar to the lecture part, teaching materials for the experimental works were also made available online at the same portal (DTU Inside). Prior to attending to the lab sheet, students were required to watch the video-based lecture and its corresponding exercises in helping them to better comprehend the purpose of the experiment and acquire the rationale behind the experimental procedures. A separate work plan was also provided, which comprised an open-ended lab sheet and the YouTube links for the video-based instructions. By using a camera phone, the videos were filmed before being embedded with a voiceover that explains each of the step being demonstrated. Besides helping to instruct the students in setting up the equipment and performing the first measurement in a proper way, these videos also guided them in performing basic data processing correctly as well as shutting down the equipment safely after finishing the experiment.

During the lab session, students were spotted to replay the videos conveniently using their smart phones[15] while attending the experimental setup at the same time. Students were earlier divided into a group of four with an intention to promote active engagement among themselves[16]. Having to work in groups, the video implementation has become more significant for each group member to be able to work collaboratively work in a more effective manner. A blended learning approach is again adopted in this case, with the presence of the instructors in the laboratory during the experiment. This is necessary should there be any queries from the students on the setup, considering the first time this new implementation was in place, or even when they were into a high-level discussion with the instructors.

3. Evaluation Results

A set of questionnaires was crafted using Google form for the students to respond to at the end of the three-week duration, on top of the regular course evaluation. Though it is not compulsory, 19 out of 32 students have voluntary responded to the questionnaires, which are in the form of five-point Likert scale[17]. The questionnaires were divided into two parts, with each focusing on evaluating students

perceptions towards video-based lectures and video-based experiment instructions, respectively.

3.1 Students perception towards video-based lectures

The first part of the questionnaires comprises four questions as below:

Q1: *I was able to cover the lecture material more effectively through the video than a face-to-face lecture*
Q2: *The video lecture allowed me to learn more on a certain topic since I was able to follow the lecture at my own pace*
Q3: *I found the video lecture to be clear and informative*
Q4: *Overall, I found the video lecture to be useful*

The results of these questionnaires are presented in Fig. 1.

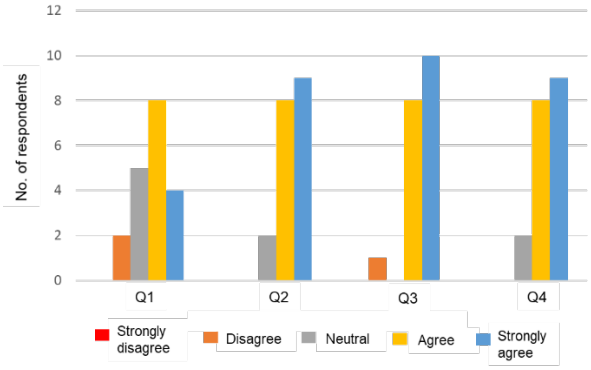

Fig. 1: Responses on the implementation of video-based lectures

Based on the response to Q2, a majority of the respondents found it convenient to be able to revisit particular topics by just replaying the corresponding video lecture at any time. The decision to branch out the videos into small parts with respect to different sub-topics has been proven to be significantly helpful in this case. The efficacy of the video lectures has also been generally acknowledged by a large majority of the respondents, based on the response to Q4. This has been the ultimate aim of implementing the video-based lectures as an aiding medium in transferring relevant knowledge to the students[18)19)].

Meanwhile, the clarity and informativeness of the video lectures has been acknowledged by all respondents except for one, based on the response to Q3. Even so, the authors will still work on further enhancement in making the videos to be clearer and informative for the next edition. Finally, the response obtained on Q1 has initiated an akin argument between video-based and F2F lectures in term of their effectiveness. From the results, more than half of the respondents rooted for the former compared to only two voted for the latter. This is a fair indication for the authors to continue incorporating video-based lectures for the same course in future, while working on necessary improvements in making this option to be more attractive among future respondents.

3.2 Students perception towards video-based experiment instructions

The second part of the questionnaires comprises six questions as below:

Q1: *The video guide/instructions allowed me to follow the experimental procedure more precisely since I was able to rewind and review certain parts that I did not comprehend the first time*
Q2: *The video instructions gave me greater opportunities to discuss with my other group members on certain experimental procedures*
Q3: *The video guide/instructions allowed me to be more prepared for the experiments*
Q4: *I found the video guide/instructions to be clear and informative*
Q5: *Overall, I found the video guide/instructions to be useful*
Q6: *I would recommend video guide/instructions for the other experiments in this course as well*

The results of these questionnaires are presented in Fig. 2.

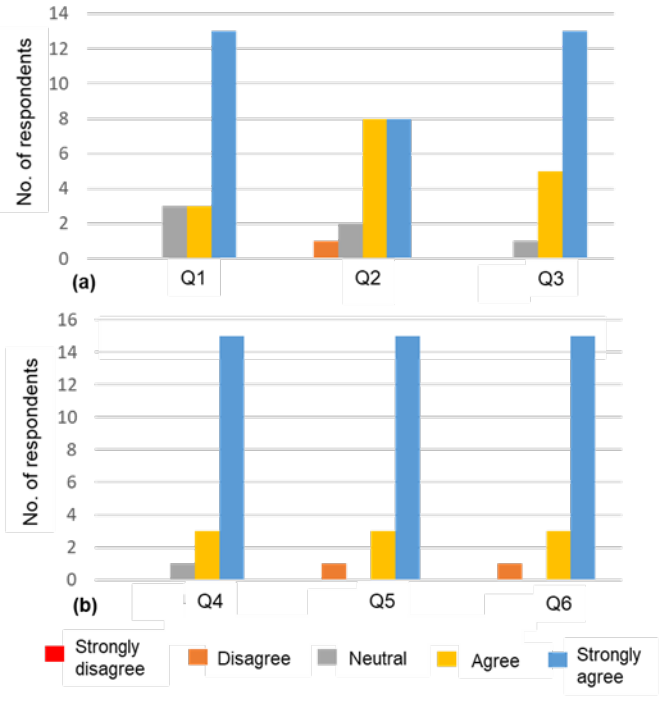

Fig. 2: Responses on the implementation of video-based instructions

Based on the response to Q2 of Fig. 2(a), most of the respondents have perceived that they have had a greater chance to discuss on the experimental procedures among their group members, which upholds the spirit of engaging

into a group discussion[20)21)]. This opportunity helped them to collaboratively coordinate among themselves throughout the whole procedures in acquiring desired outcomes of the experiment. Meanwhile, based on the response to Q1 and Q3, most of the respondents strongly agreed that the video-based instructions had helped them to follow the experimental procedures more precisely and to better prepare for the experiments, respectively.

From the response to Q4 and Q5 of Fig. 2(b), a majority of the students agreed that the video-based instructions provided were clear, informative and useful, which are among the most important characteristics that an instructional video should feature. Finally, based on the response to Q6, a majority of the respondents strongly recommended the implementation of video-based instructions for other experiments for this course in future that support all the positive responses accumulated for Q1 until Q5.

An additional question was also asked regarding the students' ability to view the videos before the experimental work session. From the pie chart in Fig. 3, all respondents managed to do so at their convenience prior to the laboratory session. This marks a strong justification towards the full adoption of video-based instructions for the next edition of the course.

Fig. 3: Responses on students' ability to preview the video-based instruction beforehand

3. Conclusions

In conclusion, students have gained many different benefits from the adoption of asynchronous video-based lectures as well as the video-based instructions for the experimental work throughout the three-week course. By having a greater chance to repetitively watch the video-based lectures, especially before joining the physical class, students were able to reach to a certain level of understanding on a certain topic that allows them to discuss with the instructors more effectively and attend the respective exercises more smoothly. This has allowed the engagement in higher level understanding due to the discussion between the students and the instructors towards reaching the higher levels on the Bloom taxonomy[22)23)].

Having the chance to watch the video-based instructions prior to attending the experiment setup, students entered the lab with a significantly more advanced level of understanding the experiment, thus making teaching significantly more efficient. The adoption of video-based contents for Experimental Fluid Mechanics have developed the students to be autonomous learners.

Similarly, the teachers also perceive that the students have been more independent and more time-efficient compared to the course from previous years. This study is hoped to be a valuable benchmark towards the full adoption of video-based instructions and video-based lectures to all topics of this course for the next edition. This may also be of interest to apply in similar practical courses with required theoretical background knowledge requirement included at DTU, the University being one of the institution complying with the Conceive Design Implement Operate (CDIO) standards for engineering students[24)25)]. A predicted challenge is to convince other instructors to make the necessary one-off time investment in converting the courses into video-based lectures and instructions. Nevertheless, we strongly believe that after completing the first video-based lectures and contents, one just needs to revise and improve the existing contents that demands a shorter time than developing the contents at the initial stage. Besides, over time and practice, one should be able to record the lectures again more efficiently, if necessary.

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