

USING VIDEOS AND DIGITAL LEARNING AS LAB PREPARATION

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ABSTRACT

Exercises in a laboratory can be a daunting task for students to take on when products are produced using complex processes and hazardous materials. Working in such settings requires the students to be sufficiently prepared, since it otherwise can be dangerous for the students. Moreover, the learning environment in the laboratory can also suffer since the students will need more guidance from the teacher on simple practical matters meaning that there will be less time for focusing ON the more important learning outcomes. Supplying the students with sufficient training can be a complex and time-consuming process. This paper will describe the findings on using videos and digital learning to better prepare the students for their work in the composite laboratory at Aarhus University, where complex production processes and hazardous materials are used for producing composite specimens, which students have conceived and designed themselves.

KEYWORDS

Video, Laboratory, Safety, Digital Learning, Active Learning, Standards: 6, 8.

INTRODUCTION

The Composite Materials course is taught at Aarhus University School of Engineering and it is findings from this course that is the basis for this paper. The course is an elective course for students on the 6th/7th semester on the mechanical engineering bachelor with a workload of 140 hours. The course is open to both Danish and international students. Number of students is about 25 each semester. The course consists of in-class lectures and laboratory exercises. The laboratory exercises take place in a lab dedicated to working with composite materials, where the students must use different chemicals, tools and machines for them to produce fiber composite specimens as part of a set of exercises. The exercises are mandatory activities in the course where the students must conceive their own design for the specimens.

Several of the chemicals used in the laboratory are classified as potentially carcinogens and a consequence of this is, that the students are required by Danish law to take an external course on the dangers of these chemicals. The students take this course before or simultaneous with the Composite Materials course. The external course, however, is not sufficient to prepare the students for working in the laboratory since most of the students have not previously worked with the types of chemicals, tools, machinery, and production methods used in the lab. For that reason, a part of the Composite Materials course is focused on preparing the students for using the laboratory.

Several years ago, the Composite Materials course was taught using a classical lecture approach which was also the case for the part of that course that was about safety and how to go about in the lab. This approach involved classroom lectures using slides about the topics given before going into the laboratory, which would often be separated by several days. It became apparent that this way of teaching this topic was not ideal. One of the problems was, that there were no additional information sources on the topics other than the teacher's slides and the information the teacher told the students during the lecture. The students had almost no ways of brushing up on the topics before going into the lab and the time spent between the lectures and going into the laboratory resulted in students forgetting most of the teachings from the lectures (Bligh, 1972). A consequence of this was that the teacher needed to repeat the instructions in use of equipment, procedures, and safety several times during the laboratory exercises. This also created a bottleneck in the students learning since all the information came through the teacher alone. Based on these experiences the course needed to be improved regarding how these topics were taught so the students could focus more on achieving the intended learning outcomes of the exercises.

This paper is based on the teachers experiences with designing and using videos and digital learning to better prepare the students for doing exercises in the laboratory and improving quality of the teaching.

VIDEOS ON FACILITIES AND SAFETY

The videos about laboratory facilities and safety have been made with inspiration from (Croker et al., 2010) and according to the following specifications:

- Length of videos should be as short as possible
- Maximum length of videos is 10 min
- Both text and speech are used to convey the messages
- Use colours, pictures and drawings when possible to underline the message
- The messages should be short and unambiguous
- Use the same name or word for a specific part, process etc. throughout the videos
- The audio should have minimal noise and the speech must be clear and understandable

A screenshot from one of the videos about safety equipment can be seen in Figure 1, where short texts, colours, drawings, and pictures have been used to convey the messages.

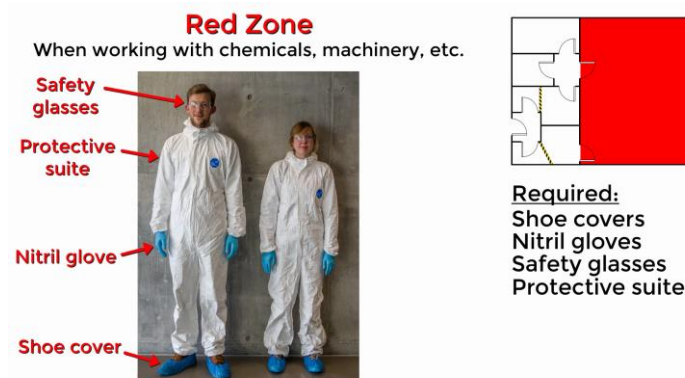


Figure 1. Screenshot from a video on safety equipment

Some of the videos on facilities and safety have been filmed in the laboratory using a GoPro strapped to the head. This is done for two reasons. The first reason is pure practicality during the filming process. Since you always have the camera with you and it always films what you are doing, then you have both hands free to handle chemicals, equipment, tools etc. and you can focus on doing the tasks while filming. The second reason is that this gives a first-person perspective for the viewer as if the person is in the lab themselves when viewing the video. A screenshot from a video on how to mix epoxy can be seen in Figure 2, where a first-person perspective is used.



Figure 2. Screenshot from a video on how to mix epoxy

The videos about laboratory facilities and safety is used in a way like a flipped classroom setup. The students watch the videos before the class as preparation where they write down any question they might have about the content in the videos. The time during class is mainly used on the teacher answering the questions and adding a few details that are not in the videos. The students will then take a written exam in the form of a multiple choice and short answer quiz about the safety and facilities in the laboratory. The students get individual feedback from the teacher on quiz results. Those who pass the written exam will then take a practical exam in the laboratory where they must demonstrate that they can use the laboratory in accordance with the information given in the videos. If they pass the practical exam, then they are granted access to the laboratory and are free to use it when solving their practical exercises during the course.

VIDEOS ON PRODUCTION PROCESSES

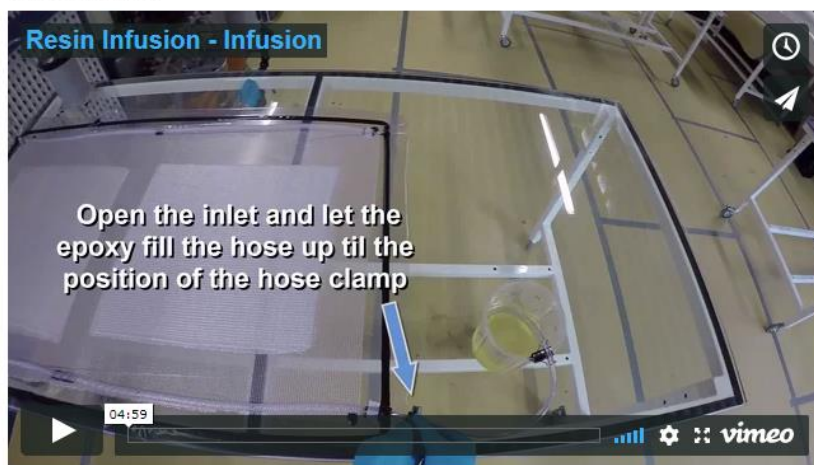
The videos about the production processes have been made according to almost the same specifications that was used for the videos about laboratory facilities and safety. The differences in the specifications are the following:

- Only text is used to convey the messages
- Background music is used
- Each production process has a series of videos describing and showing the entire production process

The choice of only using text in these videos to convey the messages was simply because these were the first videos that were made and there was not sufficient time to add speech to the videos at the time. The use of series of videos instead of just one video about a specific process is because these subjects are somewhat more complex in nature and require more time to convey the details in.

The videos about the production processes have been implemented in a different way in the course. This is because these are somewhat more complex subjects that can justify the use of E-tivities so as students can engage in active learning even before the practical exercises in the lab. The implementation of the E-tivities have been made according to Aarhus University's STREAM model (Godsk, 2013). An example of an E-tivity can be seen in Figure 3.

Video 6: Infusion



Assignment (Estimated time: 30 min)

Goal:
Insight into the infusion part of the resin infusion production method.

Tasks:
Watch the video about infusion and answer these questions:

1. Why do we apply vacuum during the vacuum infusion process?
2. What level of vacuum should we apply?
3. What could the consequence be of applying an incorrect level of vacuum?
4. Could you think of any ways to improve this production method and if so how?
5. How do you think this production method compares to the wet lay-up or vacuum bagging production methods with regards to safety, product quality, complexity etc.?

Post your answer in the forum (click the link below).

Deadline:
13-11-2017 at 20:00

Figure 3. Example of an E-tivity as part of a learning path

The students do the E-tivities before the lecture where they upload their answers to a forum before the lecture. The answers that the students have provided before the lecture will provide feedback to the teacher before the lecture, which will enable the teacher to clarify misconception at the start of the lecture. They can also be used for further discussion during the lecture.

EVALUATION

The effect of the videos has been assessed in the following ways:

- Interview with students
- Mid-term and end evaluations of the Composite Materials course both before and after the implementation of the videos in the course
- Survey amongst the students about their thoughts on the videos
- Survey amongst the student assistants employed in the laboratory
- Results from the written and practical exams in lab safety
- Observations of the students in the laboratory both before and after the implementation of the videos in the course

This is done to evaluate whether the videos have the desired effect on the students and to determine how the videos can be optimized if necessary.

Interview

Colleges interviewed some students during a peer review of a lab exercise during the spring semester 2016 where no videos were used. The students were asked about their thoughts on the exercises:

“Most of the time we don’t know what to do next and it take a long time before the teacher has time to answer our questions, so often we just try something without knowing if it is the right thing to do.” (Translated from Danish)

Mid-term and End Evaluations

Mid-term evaluation from the Composite Materials course during the fall semester 2014 where no videos were used:

” The pace in the practical exercises in the lab are slow. You are often standing in the lab waiting for others to finish their job” (Translated from Danish)

End evaluation from the Composite Materials course during the spring semester 2016 where videos about the lab equipment, selected production methods, and handling of chemicals was used:

“The lab work works well. It gives a good understanding of the different production methods and helps oneself to remember them better.” (Translated from Danish)

” The teacher is glad to help you in the lab. (Translated from Danish)

Surveys

The students from the Composite Materials course were subjected to a survey during the spring semester of 2016. The survey focused on the students’ experiences with an E-tivity about the resin infusion production method, which is a specific production method for composite materials. The survey also focused on the student’s experiences when using this production method in the lab after having done the E-tivity. In the survey the students were

asked, "Did the videos help you to better go about in the lab and perform the resin infusion?" All 27 students on the course answered yes to the question. They were also asked to elaborate on their answer and the following quotes was some of the answers given by the students:

"It's nice to have the videos and be able to watch them again if needed. It's also easier to understand the concept when you can actually see it, instead of having it explained to you."

"You are more committed/motivated to try and understand when you have to answer the questions, than if you only get the theory and don't have to do anything beforehand. You also get a chance to know what questions to ask before the lecture, instead of coming up with them during the lecture where there might not be any time left of the lecture."

"It's easier to remember the details about the specific production method when you have to find answers to the questions"

The students were also asked "What alterations/additions to the videos could improve them and why?" and the following quotes was some of the answers given by the students:

"Maybe a close-up on the gauge for the vacuum pump, as it was very hard to see what the pointer was pointing on."

"Some parts could be shortened, overall the simple tasks, since when you see the video a lot of things are very clear and fast to understand."

"Maybe tell us that we have to hurry up when the matrix has been mixed. Nobody where expecting it to harden as suddenly and fast as it did. So, to avoid panic. Make it clear that it will start to harden"

The students have all had positive experiences about using the videos and the way they have been implemented in the course. The students have especially appreciated the feedback that they now receive from the teacher during the laboratory exercises which is also an effective way of learning according to Hattie & Timperley (2007).

Observations

The students were observed by the teacher during the laboratory exercises both before and after the implementation of videos in the course. Based on these observations the videos have a positive effect on preparing the students for work in the lab. Below is a listing of some of the observations made:

- Students make fewer and most often no mistakes when handling chemicals
- Students are no longer confused or in doubt about how to use the lab in a safe and correct manner
- Students have become more self-reliant and ask fewer low-level practical questions
- Time required for the practical exercises have been reduced.
- More time in the lab can be dedicated to asking the students questions about their solutions and hearing their reasons for why they are solving the exercise that way.

- More time can also be dedicated to giving feedback to the students in the class and in the laboratory.

EXPERIENCES MAKING VIDEOS

One of the only negative aspect noted so far about the videos made for the course, is, that videos using the first-person view can have a nauseating effect if there are repeated movement of the camera from side to side.

It is also worth mentioning that the process of making the videos can be quite time consuming in all its stages from idea over filming to editing.

CONCLUSION

The making of videos for use in a course can be a time-consuming process, but once the videos are made and implemented in the course, it can be both time saving and increase the quality of the teaching. This has been found to be true both when in the class and in the laboratory during the Composite Material course.

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BIOGRAPHICAL INFORMATION

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