

# Effective use of video in engineering education

Jonas Månsson, Jennifer Löfgreen, and Per Warfvinge

**Abstract**—This workshop will explore how video technology can be used in teaching to address various pedagogical challenges, as well as some strategies for evaluating how the use of video affects student learning. The intention is not only to provide inspiration and to stimulate the exchange of experiences among the participants, but also to give insight into what current research has to tell us about the use of video and learning. The purpose of this paper is to provide a short scientific background.

**Index Terms**—video, screencast, higher education, engineering

## I. INTRODUCTION

VIDEO distribution has changed dramatically from the physical cassettes of the past to the online formats we see today. This change has opened up new possibilities for integrating video into the learning environment at all levels of education. In higher education the introduction of filmed lectures and screencasts, has provided students unprecedented flexibility in accessing and using course material. Online video resources have created new opportunities but also new pedagogical challenges that need to be addressed.

Our observation is that an increasing number of teachers in engineering courses use self-produced video to tackle educational challenges with a focus on student learning. Experiences from the academic development unit at LTH, Genombrottet (within the Center for Engineering Education) show a wide range of applications, from short and compact instructional videos to entire series of videos as the basis for flipped classroom approaches.

The purpose of this workshop is to increase the participants' knowledge of how video can be used to support student learning. We will address not only which pedagogical problems that might be solved using video technology, but also the question of how best to assess the pedagogical effects of the use of video. In the workshop we wish to explore examples from the participants' own teaching and discuss them using pedagogical theory and any empirical studies that the participants provide about their own practice. The purpose of this short paper is to provide a scientific background and an overview of some relevant research.

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J. Månsson is an associate professor at the Centre for Mathematical Sciences and an academic developer at the Centre for Engineering Education, LTH, Lund University, Sweden (e-mail: jonasm@maths.lth.se).

J. Löfgreen is a lecturer at the Centre for Engineering Education at LTH, Lund University, Sweden (e-mail Jennifer.Lofgreen@lth.lu.se).

P. Warfvinge is a professor at the Department of Chemical Engineering and the director of the Centre for Engineering Education at LTH, Lund University, Sweden (e-mail: Per.Warfvinge@chemeng.lth.se).

## II. PEDAGOGIC APPROACH

There are many sound pedagogical reasons for a teacher to incorporate self-produced video lectures or screencasts into their courses. For video material that essentially recreates live lectures, the motivation is often to improve study flexibility for students: if they miss class, students have an opportunity to catch up if they have access to lectures online. Video also provides students with an additional resource for preparing for lectures, reviewing difficult concepts, filling gaps in their lecture notes, or reviewing before the exam. The possibility of repeated viewing is also important. In subjects where mastery of a topic is important, such as mathematics, video lectures give the students a second chance to “keep on track” and fill gaps in their knowledge. The latter is very much in line with the educational philosophy of Mastery Learning; see [1].

A common way to use video is as a part of a blended learning strategy. One important such approach is the flipped classroom model, where students prepare in advance the topics that will be discussed in class. The philosophy behind the model, where [2] often is cited, is to free up valuable classroom time for interactive activities and enable more advanced discussions. Here, video can provide an additional powerful tool for students in their preparatory work.

Some possible positive pedagogical effects of video can be linked to the nature of the technology itself. Mayer's Cognitive Theory of Multimedia Learning [3] states that learning is improved when the student is presented with a combination of auditory and visual input compared to auditory and visual input alone. This suggests that multimodal approaches such as video have the potential to be successful. A similar link could be made to the framework of Media Richness Theory [4], where the level of richness of a given medium is ranked according to how well ambiguities can be resolved in a learning situation. Video, with the combination of text, image and sound, would be considered a richer medium within this framework than e.g. a textbook. The use of video as a learning tool can also help teachers address the different pedagogical needs and preferences of various groups of learners among their students.

Video content is not necessarily limited to lecture-like material, but can also cover such areas as laboratory preparation, problem solving sessions, and advanced course material for particularly interested students. The opportunities are endless. Recent years have seen new creative uses of the screencast technology, such as providing feedback, both to the student and to the teacher, and as a tool for student assessment; see [5] and [6].

### III. PEDAGOGIC EFFECT

Research shows that students in general are very positive to the use of screencasts and video lectures and find them useful; see [7], [8], [9], [10], [11], [12] and [13]. Students also claim that constant access to filmed lectures strengthens their expectations of their ability to master the course material. In [14] two major reasons for the popularity of screencasts are listed: that students use a medium where they feel at home, and that they have the possibility to review the material several times. The popularity is in itself not proof of the effectiveness of video as a pedagogical tool, but the positive student reception indicates that there could be something valuable going on from the point of view of student learning. It should be noted that students generally regard video lectures as a supplemental tool and are very clear about that they do not wish these to replace live lectures; see [12] and [13].

Although several studies have been conducted on the pedagogical effects of video lectures and screencasts, the results are vague at best. This vagueness could partly be attributed to the inherent difficulty in singling out the effect of video usage alone among all other factors, in particular in a blended format approach where video only constitutes a part of the pedagogical strategy. The choice of exactly what to measure when it comes to evaluating the pedagogical effects of video usage is therefore critical.

Efforts to find a correlation between the use of video material and student exam performance have shown little result. Some studies, e.g. [10], [13], [15], and [16], indicate that screencasts can have a positive effect on student performance, while others, [17] and [18], are not able to find any statistical difference in learning outcomes via test scores. Some studies signal that the use of video leads to increased motivation [9] and student activation outside of the classroom [14]. However, the access to video lectures alone does not, according to [19], lead to any significant difference in student activation during class.

The integration of video technology in blended learning models has shown promising results. In [20] it is shown that a flipped classroom approach with screencasts leads to increased out-of-class engagement, higher attendance, and more active participation in class. Another flipped classroom attempt, [18], also had several positive outcomes. Although the final exam results were not improved, the students reported a better overall course experience and enjoyed the course more.

Several studies, [11], [21], and [22], argue that for video to be an useful tool, the quality and the format of the video is of the utmost importance. The authors in [22] list a number of attributes that videos should have to be really effective, and [23] stresses the importance of coordinating access to the video tools with practical experience. Overall this suggests that a failure of the video resources to match the students' needs could be a partial explanation for the vague and sometimes contradictory results obtained in the various studies above.

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