

Benefiting from online teaching experiences – a collaboration between two engineering courses

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Abstract— In this paper, we present our concept for continuous and efficient course development in the context of two engineering courses during the pandemic. The aim is to streamline course development through cross-course collaboration expanding the student-to-teacher feedback loop between courses. As data sources, we rely on student surveys, teacher-to-student/teacher-to-teacher communications, as well as internal discussions with colleagues. The results from our past and ongoing investigations have identified a high potential for adopting digital teaching in parts of the courses (e.g., lectures) while there is a general desire from students and staff for integrated on-campus teaching activities (e.g., seminars or project work) resulting in a blended learning environment (e.g., flipped classroom). Apart from improving course development, additional benefits with cross-course collaboration include potential positive impacts on student learning because of increased student activity in class and greater teacher approachability. Overall, there is a great potential for an integrated and blended version of teaching. Paramount to the success of this is an ongoing process of teacher collaboration, self-reflection, student feedback and course evaluation.

Index Terms— videos, online, teaching, course development, collaboration, blended learning

I. INTRODUCTION

THE Covid-19 pandemic has posed many challenges for both students and teachers. Online course activities and the use of videos or streaming have become ubiquitous, forcing teachers and students to adapt new strategies in both teaching and learning. The transition back to on-campus courses presents a unique opportunity, as these new strategies can be used either to complement or to substitute traditional approaches such as lecturing. A successful transition can potentially result in both improved student learning and reduced use of teaching resources, the latter being increasingly important in an environment where the need for efficiency is critical.

This paper is based on our experiences as teachers at the Division of Structural Engineering, Lund University. We are responsible for two advanced courses in the Civil Engineering program. Some background concerning previous and ongoing course activities (CA) and course development activities (CDA) are presented. Thereafter a collaborative course development approach is described; this approach aims at effectively developing, evaluating, and

integrating new strategies in multiple courses. The approach is discussed in the context of the Covid-19 pandemic and its application within the two courses we teach, where efficient course development became essential for maintaining (or improving) the quality of past course cycles.

II. ONLINE TEACHING AND USE OF VIDEOS

The adoption of online approaches to teaching and learning have certainly increased substantially during the Covid-19 pandemic. Although online teaching can take many forms, video as a medium (streaming or recorded) traditionally dominates course content for online courses [1]. In the courses we teach, we used pre-recorded videos and identified potential benefits in terms of teaching and learning. Concerning pedagogic research in the field, Mayer's Cognitive Theory of Multimedia Learning [2] states that learning can be improved when presented in a multimedia format, with combined visual and auditory input. In a literature review by [3], it was revealed that the most cited reason that students choose to use videos was to improve learning. Specific applications which were noted include studying for examinations, preparing for class, self-checking for understanding, and taking better notes. Concerning teacher preference, a recent study by [4] revealed an increased popularity of self-production of videos amongst secondary and university teachers due to reduced costs & availability of equipment and software.

Existing research efforts concerning the effective use of video commonly focus on educational multimedia from a cognitive sciences perspective (i.e., within lab environment and not in a classroom) or on student perception and engagement while direct evidence concerning its effect on student performance is scarce [1,5]. One promising way of incorporating videos in teaching cited in the literature is through the Flipped Classroom teaching method. In a flipped classroom, traditional classroom-based instruction is given as homework (e.g. using video lectures) allowing for a more flexible use of in-class time (e.g. for applying the knowledge or having more in-depth discussions) [6]. In addition to the potential academic improvements, more cost-effective teaching is also cited as possible incentives for adopting this method.

III. THE STORY OF TWO ENGINEERING COURSES

The courses referred to in this paper are advanced courses for students within the Civil Engineering program at Lund University, Sweden; their development between 2019-2021 is given in Fig. 1. Course 1 is a 5th year course on Bridge design given during the entire fall (LP1&2) while Course 2 is a 4th year course on Concrete structures given during the

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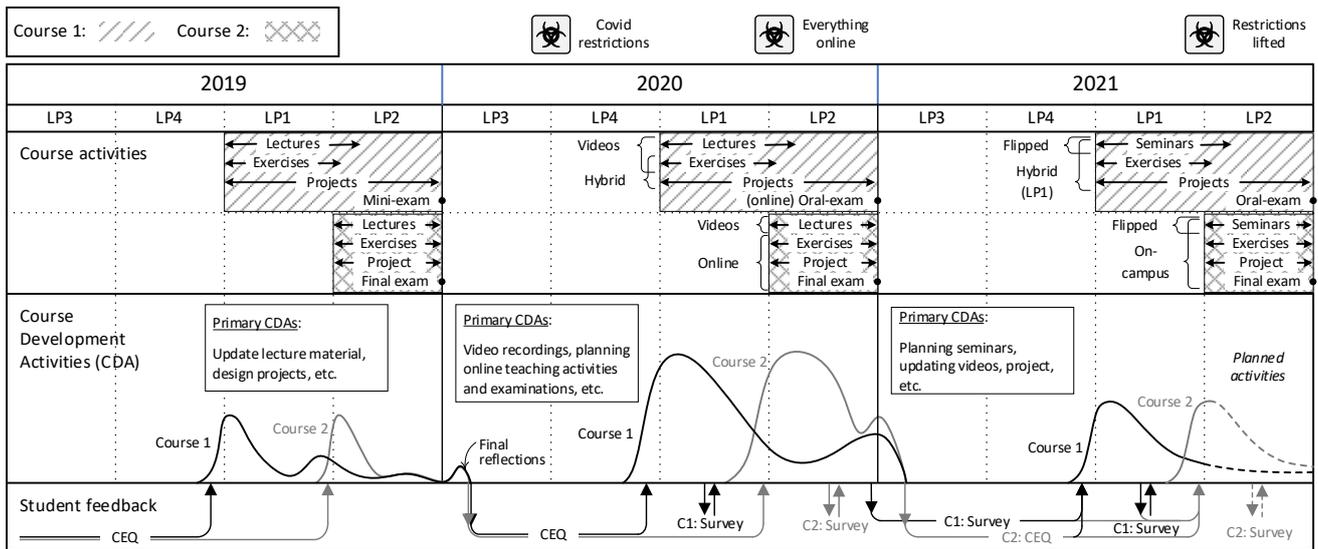


Fig. 1. An overview of course activities, course development activities (CDA) and student feedback for the two courses from 2019 until 2021. During 2020 significant changes were introduced (pre-recorded videos, online teaching) along with mid-course evaluations; these supported the third course iterations in 2021 where a cross-course collaboration approach was adopted; see Fig. 2.

second quarter of the fall term (LP2). In 2019, course activities (CA) within both courses included on-campus lectures, exercise classes, project work and written examinations; Course 2 also included a lab assignment. Course development activities (CDA), which we define as any change to the preceding course iteration, would take place in response to the previous year's course evaluation and teacher reflections (including course evaluation questionnaires, CEQ). Specific changes were, however, often limited to updating lecture slides, altering portions of project assignments, etc.

In spring 2020, restrictions concerning teaching at Lund University were introduced and by mid-fall all teaching (with some exceptions) was held online. In Course 1 a conscious decision was made to have pre-recorded video lectures while exercise classes (which involved industry practitioners helping the students) were held on-campus with the option of attending online. When Course 2 started, online teaching was effectively a requirement and lectures were pre-recorded while online exercise classes and consultations were also provided. Both courses required significant work in relation to previous years and CDAs included: recording/editing lectures and/or exercises; organizing online/hybrid teaching and learning activities; preparing/administering online labs and/or examinations.

Although the workload was high during 2020, we identified some potential for using the developed course materials (e.g., videos) in future course iterations and specifically for adopting a blended teaching and learning approach (e.g., flipped classroom). To aid us with our efforts, student surveys were created investigating the course participants attitudes and perceptions towards online, on-campus and blended course formats. Formal and informal discussions were also carried out with colleagues to gain additional insight.

The end-of-course survey results from 2020 for both courses showed that the students were overall very satisfied, although there was a clear desire for returning to on-campus activities. In fact, the CEQ of Course 2 improved on all relevant accounts from the year prior. While this might

imply that students prefer the digital version, the results may in part be attributed to the students experiencing a smooth transition to digital teaching *relative* to other courses. In the other survey, about half of the respondents noted the flexible nature of recorded video (not having to follow a fixed schedule and being able to rewind and adjust playback speed) as a positive aspect. However, this aspect was also mentioned as a flaw in the online course format; where some students prioritized other course work and only viewed the videos prior to the exam. Another interesting conclusion was the importance of the technical properties of videos such as length, video, and sound quality.

Concurrent with the easing of restriction in fall 2021 was the possibility to incorporate more on-campus activities. This allowed for utilizing digital teaching material from the previous year without having an online course. A flipped classroom approach was adopted in both courses based on the positive feedback to this approach from the surveys and with support from the literature [6]. Specifically, this consisted of online pre-recorded video lecture series which were to be viewed prior to voluntary on-campus seminars (online participation also possible). This was approach also addressed one of the cited limitations of pre-recorded video, namely, the lack of structure. In addition to changing course formats, we also decided to become actively engaged in each other's courses and CDAs.

At the time of writing this paper, the courses are ongoing although a preliminary evaluation (based on a mid-course survey in Course 1) indicates that the students are very satisfied with the new course format. Nearly all the students have attended each seminar (mostly on-campus) and watched the relevant videos prior. In class, we presented the findings of the mid-course survey, our own reflections as well as some plans for future changes, e.g., in the seminar format. In this way we extended collaboration of CDAs to include direct student participation; an effort we felt was appreciated. The most current seminar format, which has received positive feedback, utilizes an online interactive presentation tool *Mentimeter* (www.mentimeter.com). In Course 2, we plan to continue our collaborative approach,

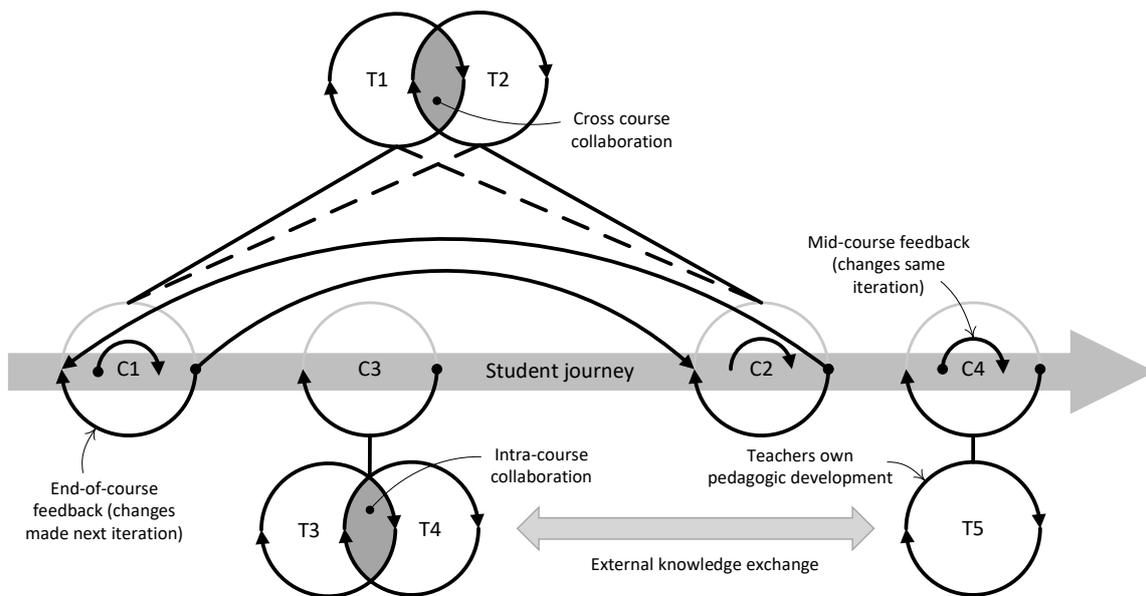


Fig. 2. An illustrative model for the collaborative approach used. C# refers to course no. # and T# the teacher(s) responsible for this course. The large grey arrow indicates the students' journey through each course while the arcs with arrows refer to course or teacher developments and feedback. Traditionally (below the arrow) each course is kept separate while knowledge sharing occurs outside CDAs; the collaborate approach extends this facilitating joint experience sharing.

explicitly informing students that their feedback may help to improve, in addition to Course 2, other upcoming courses as well (of which Course 1 is potentially one).

IV. COLLABORATIVE APPROACH TO COURSE DEVELOPMENT

The approach we adopted in our two courses in 2021, illustrated in Fig. 2, can be described as a direct *cross-course collaboration* between (us) teachers which utilizes direct feedback from students as the courses are ongoing while retaining end-of-course feedback for future course iterations. The latter can also provide feedback between the courses given the course formats are the same. Cross-collaboration according to our definition also entails *intra-course collaboration* since two or more teachers are sharing a course, enabling each teacher to directly experience the course. This process is further strengthened by other teacher collaboration activities including *indirect* knowledge sharing activities (e.g., formal/informal discussions at division or faculty level).

A benefit with cross-course collaboration is that it allows each teacher to be directly involved in CDAs in another course while getting help in their own course. In our case we help each other plan the flipped classroom seminars as well as the course evaluations. As this is an exchange, the workload is not altered and the fact that two teachers are involved has helped accelerate the course development process providing insightful commentary and suggestions.

A long-term benefit which we identified concerns the introduction of a feedback loop between courses. As the courses are part of a succession in the students' educational journey, there is a transfer of knowledge between courses and not just within them. This may provide added incentive for students to provide constructive input in their course evaluations. In the long term this approach can facilitate a harmonization of teaching approaches as well as provide the students with some more familiarity with the teachers responsible for future courses. The latter could also increase teacher approachability, a quality students rate highly [7].

V. CONCLUSIONS

Combining on-campus teaching with online strategies developed during Covid-19 could have a lasting positive impact on student learning. Cross-course collaboration can be used during the transition period to streamline the cycle of student feedback within and between courses. This may strengthen course development activities (CDA) connected with adopting blended (or any new) course format in multiple courses. Other potential benefits of cross-course collaboration include added incentive for leaving feedback and increased familiarity between students and teachers. Survey results from the two courses in this paper indicate that while students desire to return to campus, they have an overwhelmingly positive attitude towards using digital media recorded in the courses. Speculatively, this could point towards a successful transition from traditional on-campus lectures to a blended learning environment consisting of pre-recorded videos combined with seminars.

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