

The best of both worlds – synergizing video learning and face-to-face instruction in undergraduate axiomatic geometry

Yael Fleischmann¹

¹Norwegian University of Science and Technology, Norway; yael.fleischmann@ntnu.no

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Background and theoretical context

The integration of video lectures and Inverted Classroom Teaching (ICT) into university courses has become increasingly prevalent in recent years, particularly in light of the COVID-19 pandemic and its impact on traditional teaching practices. The concept of ICT, also known as “flipped classroom”, aligns with the constructivist learning theory, which states that knowledge is constructed through experiences and interactions with the environment (Piaget, 1970). ICT has gained popularity in recent years, and its effectiveness has been evaluated through various studies and research. In response to the pandemic, a number of universities were forced to transition to online or hybrid teaching models, including the Norwegian University of Science and Technology, where the author has conducted a university course on axiomatic geometry four times between 2020 and 2023, each time adapting to the changing pandemic situation. The different adaptations of the course design are related to the process of design-based research (Brown, 1992), following a cyclical process, in which the didactic course concept has been repeatedly refined based on external requirements, systematic feedback collected from students through questionnaires, and experiences reported by the teaching staff involved. ICT involves flipping the traditional classroom structure and focusing on students’ active learning. It allows students to explore and apply their knowledge through hands-on activities, facilitating the construction of knowledge. The approach has been shown to be effective in increasing student engagement and motivation in mathematics education (Turra et al., 2019). Video-based courses, that is, those making use of learning videos as a major part of the preparation of the live meetings, play a crucial role in ICT. However, it is important to recognize that not all students may find it easy to engage with online materials (like videos) and some may require additional support. To maximize the impact of video-based courses, educators should incorporate a variety of didactical approaches, such as (online) discussions, (virtual) tutoring sessions, or interactive elements. The study presented here aims to address the following question: *How can ICT and more traditional teaching approaches be combined in a university course on axiomatic geometry, and how do students respond to it?*

Course design and preliminary results

The variations of course design from 2020 to 2023 are presented in Figure 1. The integration of traditional in-person lectures and video lectures is facilitated in the considered course by using complementary gap texts, which serve as supplementary materials for students to support their notes during lectures or video viewing. Since they were first implemented in 2022, the interactive campus meetings entail individual or group-based student engagement in different cognitively challenging tasks, including problem-solving and quizzes. The lecturer answers questions and repeats significant

video lecture outcomes on request. Students are provided with tutor groups to facilitate collaboration on weekly homework assignments. The format of these groups remained largely unchanged for four years, with only occasional adaptations to digital formats necessitated by the pandemic situation. Since 2021, data has been collected from participants through qualitative and quantitative methods. Despite efforts to distribute questionnaires to all students enrolled in the course (with a range of 108 to 123 students per year), the response rates were low, with only 28% (2021) and 15% (2022) of the enrolled participants completing the questionnaire. The results of the evaluations indicated that the students generally rated the lecture concept positively, with an average score of 8.2 (2021), respectively 8.3 (2022) out of 10 points. The effectiveness of the gap text was evaluated with a lower average score, with a mean of 6.8 (2021) and 5.8 (2022) out of 10. However, participation in the scheduled synchronous meetings was limited, with only ca. 10-20% of enrolled course participants in attendance, both for digital meetings in 2021 and on-campus meetings in 2022. In response to this, the 2023 iteration of the course was designed to include a higher number of live on-campus lectures, aiming to increase student attendance and participation in interactive sessions. Results from the data collection conducted in 2023, focusing on students' video usage frequency and preparation level for interactive lectures, are presented in the poster.

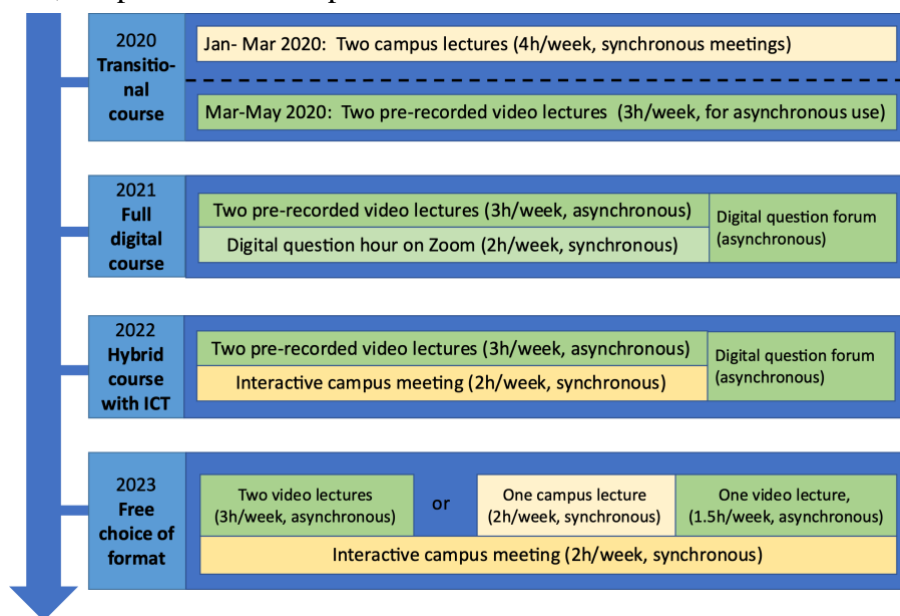


Figure 1: Different course designs from 2020 to 2023

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