

Experiences from introducing Flipped Classroom as an alternative to a traditional lecture format

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General introduction

“I once heard somebody describe the lecture method as a process whereby the lecture notes of the instructor get transferred to the notebooks of the students without passing through the brains of either.”

- Eric Mazur (Mazur, 2009), referencing (Huff, 1954) -

While this quote may paint a very bleak and somewhat exaggerated picture of the traditional lecture format, the present project was initiated to try to change the mode of interaction in large-enrollment lecture formats. While some lectures, or lecturers, can certainly captivate and activate the audience and efficiently convey an improved understanding of a subject, this format does not always have those effects. From our own experience, both as students and as lecturers, the classic lecture format can easily become a strict one-way communication of knowledge, with very little active student participation or interaction. In the following text, we will outline a target lecture in a mandatory second-year veterinary medicine course, describe our intervention in terms of planning and execution, and go through the student evaluations, as well as our own evaluation and take-aways. We hope that this will inspire others to attempt similar changes to their approach to teaching.

Background

We chose to conduct our intervention during a course run at our department. SVEB13006U Mikrobiel Fødevaresikkerhed (Microbial Food Safety) is an obligatory bachelor course for Veterinary students located in block 4 of their second year. The course typically enrolls around 180 students.

The course consists of a theoretical part and an associated laboratory course where the students are trained in techniques of relevance to microbial food safety. For the theoretical part, the course is organized by dividing the overall topic into smaller themes with associated lectures. The lectures are typically 45 min. and structured so that the teacher first introduces the specific learning outcomes for the lecture followed by an introduction to the topic (PowerPoint presentation) for approx. 20 min. To activate the students, this is usually followed by small exercises f.ex. cases, quizzes or other types of small assignments that the students work on in groups for 10-15 min that are then discussed in plenum. At the end of the lecture, the lecturer summarizes and discusses the results of the exercises with the students that at this point also will have time for questions. However, with 180 students the teacher-student dialogue is often very challenging as the teacher can only interact with very few students during the discussion in plenum. As a teacher, it is therefore difficult to assess if the learning outcomes have been achieved by the majority of the students. Furthermore, we have observed that many of the students check their social media, browse on the internet etc. during the lectures. Thus, the lecture format seems to promote a poorer learning environment where the students easily become distracted and lose focus. The official course description can be found online (course ID: SVEB13006U).

Selected take-aways from previous student interviews

A part of the foundation for this intervention comes from the results of our previous UP pre-projects, for which we planned and conducted interviews with students studying veterinary medicine, biotechnology, and computer science focusing on different aspects of student learning. One of the aims of this assignment was to gain insights into how the students perceive and experience university teaching and what they see as important in terms of supporting their learning outcomes. While these interviews were limited in scope and relied on small focus groups, we will highlight key insights that we find valuable related to flipped classroom approach. The specific points that we will bring up here are:

- I) The perceived importance of course structure and information required for the students to maximize their learning outcomes
- II) The importance of delivering a teaching activity that the students will prioritize
- III) The perceived importance of video lectures.

Setting up and communicating a clear course structure was underlined as a key factor allowing the students to navigate the course efficiently, and to limit the stress that could stem from not knowing the extent or expected time allocation of specific tasks or assignments. When planning the activities, another student emphasized the importance of providing a learning activity that is worth showing up for. Essentially, avoid repetition of course materials, as this information is already available from books, course notes etc.

Finally, regarding their preparation for course activities, a wide variety of sources and materials were mentioned by veterinary students interviewed. These included a strong preference for video recordings of lectures:

“It [watching video lectures] takes the pressure off during the actual lecture where the focus will be on whether you have time to take the right notes and allows you to be more present during the actual lecture” (Anonymous veterinary student).

It is important to note that these video lectures were live recordings from Zoom lectures taught during the course and therefore not accessible to the students prior to the lecture but uploaded to the online study portal Absalon afterwards.

Goal of the intervention

The overall goal of this intervention was to facilitate a more dialogue-based and interactive learning environment when teaching large groups of students (approx. 180), e.g., in a lecture setting. Specifically, we wanted to try a Flipped Classroom (FC) approach in order to move away from the traditional one-way communication between a teacher and attending students. The hypothesis was that this format could help us move past the two lower levels of the revised Bloom’s taxonomy (understanding and remembering, Rienecker et al., 2013), and cultivate a more interactive learning environment.

A quick primer on Flipped Classroom

According to the Vanderbilt University Center for Teaching, the FC format has evolved through different areas of teaching (Brame, 2013). At its core, the FC format is characterized essentially as the inverse of the traditional lecture format. Briefly, the traditional format provides the initial exposure to the topic in question during the lecture, followed by subsequent reflection and higher-level cognitive processing by the student after the lecture. In the FC format, the flip entails that initial exposure to topics occur prior to the lecture, as preparation, whereas the higher cognitive level processing takes place during the lecture. The role of the lecturer in class, thus transitions from being the sole source of knowledge and only point of focus, towards being a facilitator of learning through active student participation in the form of group work, problem solving or similar tasks that address the higher cognitive levels of the modified Blooms taxonomy.

Part of the theoretical foundation behind this reshuffling of learning activities lies in the active and interactive work with the study subject during class activities. Levinsen et al describe the importance of personal experience gained from actively working with the subject at hand in enabling better learning outcomes (Schunk, 2016). Further, the authors emphasize the importance of both intrapersonal and interpersonal learning processes by which the student not only internalizes and processes the subject material in isolation but does so through interactions with her or his surroundings. In particular, the interpersonal process can then facilitate an improved, more complex understanding of the subject by being challenged and having to formulate views and opinions using subject specific terminology and logic.

Practical examples include Eric Mazur, an early adopter of this format, putting students in charge of the acquisition of information and preparation prior to class, so that time in class can be spent processing and exploring the details of the topics in question (Mazur, 2009). A similar approach has been described by Jan Halborg Jensen, UCPH (Jensen, n.d.). Briefly, Halborg Jensen describes a format where students prepare prior to teaching activities by watching short video lectures. Formative feedback is then provided by a short quiz that also acts as an incentive, emphasizing the importance of preparation, and feedback to the instructor on how well the topic was understood. Both Mazur and Halborg Jensen then lean on peer instruction during the lecture, meaning that the students work on, discuss and answer plenary questions and receive formative feedback.

In relation to our intended goal, the FC format would provide a structure in which the students work with, rather than listen to, the subject matter during class. However, even more importantly, the format should allow the lecture to become more interactive. The FC format should enable us to take some of the strengths of lab-exercises and small-class teaching with their potential for student-student and student-teacher contact and discussions, and transfer them to the auditoriums, thus being able to help break the one-way communication that we observe as the standard during large-enrollment lectures.

Strategy and description of the flipped classroom activity

A single lecture from the course “Mikrobiel Fødevarerikkerhed” (“Microbial Food Safety”) was changed from its traditional 45-minute lecture format to a Flipped Classroom (FC) format.

The topic of the lecture was on the biology, relevance and detection of the bacterial food-borne pathogen *Campylobacter jejuni*. The planning and execution was inspired by descriptions given by Halborg Jensen (Jensen, n.d.), essentially following the didactic model described by Levinsen et al (Schunk, 2016), as shown below (Figure 1).

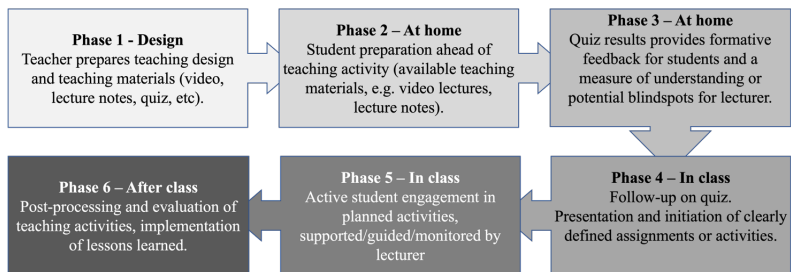


Figure 1. Didactical model of the applied FC format. Adapted from Levinsen et al (Schunk, 2016).

Following the model above, material was prepared during phase 1. These materials consisted of 1) a 22 minute video lecture, and a short review

quiz based on the content of the video lecture, II) a PDF document describing an in-class assignment based on a case study and previous exam questions, III) a Padlet, an anonymous online tool, to collect and show student responses to the in-class assignment real-time during the flipped lecture, IV) a PowerPoint presentation addressing the questions and corresponding short answers to the in-class assignment to follow up on the Padlet and V) a Padlet for student evaluation of the FC format used at the end of the lecture. While video lectures are not a required component for FC formats, this medium seemed to be in line with the lessons learned from earlier student interviews. Also, the possibility to reply anonymously to questions/tasks was mentioned during the student interviews thus making the Padlet platform ideal.

Already when introducing the course to the students they were informed that the *Campylobacter jejuni* lecture would be different from the other lectures, and that it would be important for them to pay attention to updates related to this on the online study portal Absalon. One week prior to the flipped lecture, the students were notified via Absalon what materials they were expected to go through prior to the lecture (phase 2), and that they were expected to take the associated quiz (phase 3). The quiz was set up with a deadline the day before the flipped lecture and to allow only one attempt by each student.

Prior to the lecture, we reviewed the quiz answers. A total of 54 out of around 180 students had taken the quiz. The answers given indicated that an important aspect of *C. jejuni* biology had been missed by a number of respondents. This allowed us to pay more attention to this specific aspect during the lecture (phase 4). During the lecture itself, we were both actively involved in the teaching. Following a short introduction, the students worked on the in-class assignments supported by us, until the responses were discussed in plenum and answers summarized using the PowerPoint presentation. At the end, the students were asked to evaluate the format (phase 5/6). The lecture itself in terms of tasks and time management, is outlined further in the following Figure 2:

Minutes	Phase	Activity
5	4	Short welcome and presentation of the FC format. A short review of the quiz replies was given, adding an explanation of the above mentioned misunderstandings observed from the replies to clarify. We then introduced the assignments, making an effort to make it clear what type of answer would be expected (numeric result, short explanation, short discussion, etc.).
10		
15		
20		
25	5	I) The students formed working groups and started with the assignments. We circulated in the auditorium, engaging the students, asking and answering questions and tried to facilitate the students' effort to solve the problems they were presented with, after which they entered their anonymized replies into a common Padlet.
30		
35		
40		
45		
50		
55	5/6	II) After approximately 20 minutes, the replies entered into the Padlet were discussed in plenum. For this purpose, a PowerPoint presentation with answers had been prepared in advance. During this walk-through, we tried to start discussions, rather than just state "True" or "False". This step took appr. 5-10 minutes.
60		Brief introduction to student evaluation, Padlet setup and quick wrap-up.

Figure 2. Tasks and time allocation during FC lecture.

Evaluating the intervention

Student evaluation of the intervention was performed in the last five-ten minutes of the lecture using the online tool Padlet as an online questionnaire covering four specific questions. The students were asked to reflect on their perception of the strengths and weaknesses of the FC format, and to rate the format relative to a traditional lecture, in terms of learning outcome. Selected quotes have been translated to English as presented here in this section.

Question 1: What worked well

Overall, most of the students completing the online survey were positive towards the FC approach. Several students highlighted the video format as one of the benefits of the flipped classroom as it allows the students to see the lecture repeatedly at their own pace and as a nice alternative introduction to a new topic.

“Nice to be able to take the [video] lecture at your own pace. Great to get to work with the topic material” (Anonymous veterinary student).

Also, the in-class assignment and the opportunity for the students to use their new knowledge was mentioned by several students as a benefit of FC. Furthermore, group work and discussion with fellow students was also emphasized as a positive outcome of the flipped lecture.

“You are better [prepared], as you are “forced” to acquaint yourself with the material. Really great with the assignment that followed, so that you work actively with the subject material and get an even better understanding of the topic.” (Anonymous veterinary student).

“Super great to have to think for yourself” (Anonymous veterinary student).

“It worked well to see the video at home and to work with it [the topic] in groups” (Anonymous veterinary student).

Finally, one student reply addressed the important fact that participating in discussions in a large-enrollment class can be overwhelming, whereas anonymity as provided by the Padlet tool can help facilitate inputs from some students.

“...The padlet is good, maybe less anxiety-provoking for many.” (Anonymous veterinary student).

Question 2: What did not work well

The preparation at home was mentioned by some students as a drawback of the FC format. Also, the physical settings being in a traditional lecture hall was mentioned as an important factor in relation to not making group work optimal as well as not enough time was set aside to discuss and work on the assignment in the groups.

“I usually don’t prepare ahead of a lecture, and actually like it better when turning up for a lecture unprepared, and then reading up on hard things after the lectures”

“[It was] A little hard to do group work in a lecture hall” (Anonymous veterinary student).

Question 3: How can we improve the FC format

Several students requested more time to work on the assignment in groups demonstrating the importance of balancing the timing of the different elements of the FC format. Also, the lack of experience with this type of teaching format clearly impacted the students’ experiences.

“More time for the exercises. You can change it so that we have to do a lot more of this because [we] got so much more out of this” (Anonymous veterinary student).

“We are not used to this kind of teaching at all, so we are a bit slow regarding interaction. Sorry.” (Anonymous veterinary student).

From the number of quiz responses, as well as from the evaluation, it was clear that most of the students had not noticed the information and course updates regarding the change of format for this lecture. Thus, better communication about the preparations prior to a flipped lecture was mentioned as preparation ahead of lectures seemed to be an uncommon practice for some.

Question 4: Grading the FC format

To have a more quantitative evaluation of the FC format we also asked the students to grade the lecture to a traditional lecture format in terms of learning outcomes where 1 is “much lesser learning outcome than traditional lecture”, 6 is “equal learning outcome” and 11 is “much higher learning outcome”. Overall, the majority of the replies indicated higher learning outcomes than the traditional format (median = 7, total replies = 27, see Figure 3 below).

In addition, one student also further elaborated on the grading in relation to the alignment between the FC teaching formats and exam:

“8 in terms of understanding, but exams are extremely based on rote learning and not so much on whether we have understood/can use the methods, but extremely minute details must be remembered. So [I] would be nervous about whether or not exam performance would decrease if the teaching is more flipped-classroom-based” (Anonymous veterinary student).

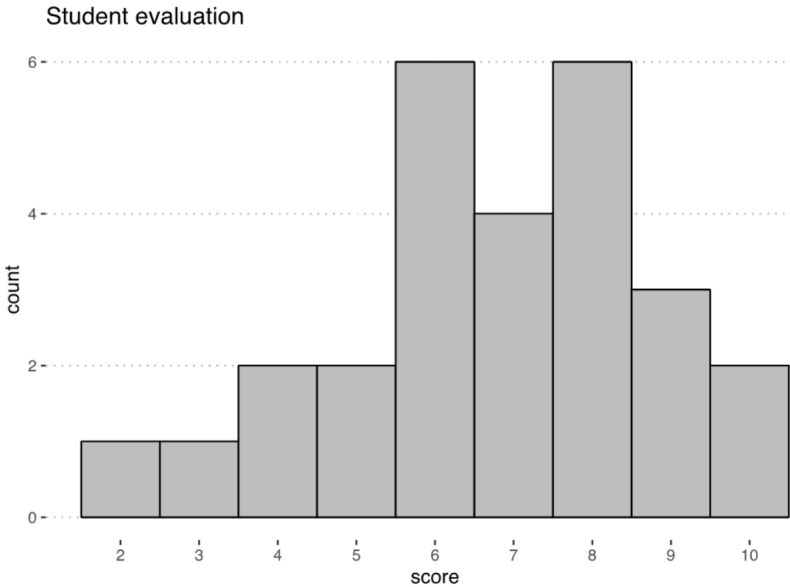


Figure 3. Histogram of student responses to the question: “On a scale from 1 (much lesser learning outcome than traditional lecture), through 6 (equal learning outcome), to 11 (much higher learning outcome), what is YOUR impression of this teaching format?”

Own reflections

Did we reach our goals?

Keeping in mind that we only intervened during a single lecture, we were left with the impression that we had more active dialogue with the students. A few key points are worth highlighting in that regard:

- *Divide and comfort*: During the active problem-solving (phase 5), the students were able to form groups, despite being in an auditorium. Interacting with the students in smaller groups rather than the full auditorium seemed to lead to more natural and relaxed back-and-forth dialogue, when the students needed assistance.
- *Safety in numbers*: Since tasks were solved in groups, specific students are not singled out, but speak on behalf of their group.

- *Strength in numbers*: Having two lecturers allowed us to cover more questions and discussions during the active problem-solving. Subsequently, during the following plenary discussion, we were able to supplement each other with one of us engaging in discussions, while the other prepared the next talking point, followed up on details or participated in the discussion. This extra support appeared to facilitate the process.

Following the intervention there was a perceived increase in student willingness to participate in discussions during subsequent teaching activities. Additionally, four of the students later mentioned that because of the way their study program is structured it is often very difficult for them to find time for group work between lectures and practicals. The FC format promotes a scheduled timespan for the students to be present at campus focusing specifically on interactions such as group work. Thus, this teaching format makes it easier for the students to take part in group activities promoting deeper learning. Along with the overall positive evaluation from the students, we have taken a significant step towards achieving the goals for this intervention.

Areas to improve and learn from

All in all, the FC format appeared to be successful. However, as evident from the student evaluations, there are things to consider, specifically regarding the structure of the format, as well as the lecture itself.

A major issue to consider is that our intervention does not occur in a vacuum. The switch in format was for one lecture only and is bookended by traditional lectures in the course. Further, while a few student replies indicated that they had tried a FC format prior to this, the students did not appear familiar with this type of teaching from their previous courses. As indicated in our earlier student interviews, structure and transparency in course planning and workload management are very important to students, as indicated from the student interviews mentioned earlier, a “sudden” switch of teaching format, and the preparation required along with this switch, is at a disadvantage from the start. Future implementation of FC formats should take this into consideration, and explicit communication and instructions, as well as a brief introduction period at the start of the course are advised. For this lecture, only a minor subset of the students

completed the questionnaire before the deadline, and many seemed unprepared. While the in-class assignments included more general material, as well as *C. jejuni* specific tasks, it is clear that the students who had prepared benefited a lot more from the flipped classroom compared to those who had not prepared. Essentially, the format will need more time in order to be fully implemented.

Regarding the active student participation (phase 5), we included too many questions, given the time constraints. A proposed improvement would be to include a smaller base set of questions and including additional questions as a supplement for students/groups who solve the base set quickly. Dividing the questions this way, could act as an incentive for stronger students/groups, without putting too much pressure on the rest of the students. Furthermore, it could help focus the effort, so that as many as possible makes it through the base set, improving the learning outcome of the plenary follow-up.

Also, it should be mentioned that at least one student felt that the use of anonymized answers via Padlet was less anxiety provoking than participating in a normal plenary discussion. Along with the general pressure described during student interviews felt by the interviewees regarding study programs, exams and a requirement for performance, we should make a conscious effort to ameliorate this pressure by planning teaching and -formats so that we can accommodate as many different personalities as possible.

Finally, one concern raised by a student is the alignment between the FC format and the course exam. Specifically for students studying medicine and veterinary medicine some exams are based on rote learning i.e. memorisation of very specific details. Ensuring congruence and alignment between the course content, teaching format and exam is however important for all courses.

Peer-feedback

The planning of the intervention described here was done with inputs from a department supervisor directly involved with the course. Briefly, input on the in-class assignment and the number of questions were discussed as well as the timeline of the FC lecture.

Prior to finalizing this document, our respective department supervisors, one of whom is directly involved in the course in question, and both of

whom have extensive experience teaching within this study program, were asked to comment on our report.

One of the points mentioned as peer feedback to the first draft of the report was that the purpose of the student interviews was not clearly described. We have therefore added this information in the report. Also, as only selected student quotes are translated and presented in the actual report it was noted that these could appear “cherry-picked” highlighting only specific points of interest to us as authors. We have however added quotes both pointing to pros and cons of the FC lecture as mentioned by the students. While part of the original assignment paper, the full list of quotes has been omitted in this anthology version to limit the length of this entry

The somewhat provocative opening quote led to a feedback comment on the lecture format itself, with TED talks being brought up as examples of what a good lecture can be, when the students/audience arrives unprepared and are stimulated and entertained. We agree that this is true for some lectures and lecturers, and we have therefore moderated the initial description to reflect this. The quote still stands and has thus already done its intended job.

Another point of feedback pointed out that student interaction and participation could also be seen in lab-exercises, theoretical exercises and case-work. This is an interesting point that led to an improvement of our description of what we hoped to achieve by implementing the FC format, namely, to transfer those qualities from more intimate teaching formats to large-enrollment lectures.

The final points of feedback questioned the efficiency of video lectures and group work. Specifically, from one peer’s own experience, the main strength of the videos lay in their use during exam preparation, not as an initial exposure to the subject, while group work tends to focus on prioritizing information in terms of importance and does not necessarily promote deeper learning. These are valuable experiences, however, when implementing the FC format described here, the videos will be available prior to the teaching activity and throughout the remainder of the course and exam preparation period. By having the videos as a primary exposure, the idea is that the students will be better equipped to discuss, challenge and work with the subject, as the interpersonal aspects of learning and interactions are among the key reasons for adopting this format.

Conclusions and perspectives

Overall, we think that changing a traditional lecture to the FC format in a large classroom setting worked very well both as teachers, but also based on the generally positive evaluation from the students. Clear communication about the format and ensuring that the students are prepared prior to a flipped lecture are crucial elements in making this teaching format a success. We propose that avoiding switching between lecturing formats and implementing the FC format in all lectures during a course could be an optimal teaching strategy ensuring consistency for the students in terms of planning for a specific course.

Also, the in-class assignment in terms of complexity and number of questions the students will be working with, will be something that may need to be adjusted over time. We propose that by making some questions optional this issue could be solved to also address the student diversity particularly in a large classroom setting. However, it is clear that the FC format allows more complex assignments addressing higher cognitive learning outcomes that can be addressed by discussion both with fellow students through the group work but also with the teacher. This form of immediate formative feedback is expected to enhance the students' learning outcomes in a flipped lecture compared to a traditional lecture.

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