Reversing the classroom: Flipped Learning for Forensic Medicine´s Legislation Module

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Current setting and motivation

The MSc course "Course and Exam in Forensic Medicine", UCPH, has approximately 200-250 medical students enrolled each semester. The exam is mandatory and without aids. The course is placed at the end of the 2nd year of the master's degree program in medicine and is taught in Danish.

According to the course description, the course introduces medical students to forensic medicine and the legislation in connection with the practice of medicine (https://kurser.ku.dk/course/smea15044u/2024-2025). The legislation module consists of a 3-hour lecture (3 sessions of 45 minutes) for all students with one teacher on the fourth day of the course, followed by a one-hour (65-minute) session conducted in small groups of 20 students, facilitated by two teachers, scheduled across the fifth to seventh days of the course. I have been teaching this module with different co-teachers since 2019.

In the current setting, the lectures cover the legislation theory, and the classroom teaching covers two problem-based cases with group work and discussion. The teachers are medical doctors with a specialist training in forensic medicine and do not have any educational background in law. The intended learning outcome (ILO) of this module is that the students must be able to explain the principles for applying the legislation in the practice of medicine.

The current setup in the lectures is mostly traditional and teacher-centered, although the lectures do include some elements of a student-activating approach using in-lecture quizzes for individual student voting. Hence, the pedagogical challenges of lectures as merely transmittance of

information and promotion of surface learning and passiveness among students do exist. From the perspective of the didactical triangle, the current setting places the teacher and the content in the center. However, to facilitate a deep learning approach, it is important to move from a teacher-centered teaching to a more student-centered approach, putting the students and content at the center and the teacher in a facilitating role (Mørcke & Rump, 2015).

Motivation

The whole course was reorganized several years ago with a focus on introducing more active learning through problem-based learning and demonstrations. As a result, the course has one of the highest scores in course evaluations in the master´s degree program in medicine at UCPH. To improve an already well-functioning course, I reviewed the past years´ student evaluations and noticed that students continuously asked for quizzes. In combination with my own experience, that students in these lectures seems passive, I wanted to introduce the flipped learning approach, both to increase students learning through a more student-centered lecture and to develop my teaching skills according to Kugel´s phases of teacher development (figure 1). As a result, I decided to implement the use of quizzes in combination with a flipped classroom approach in these lectures.

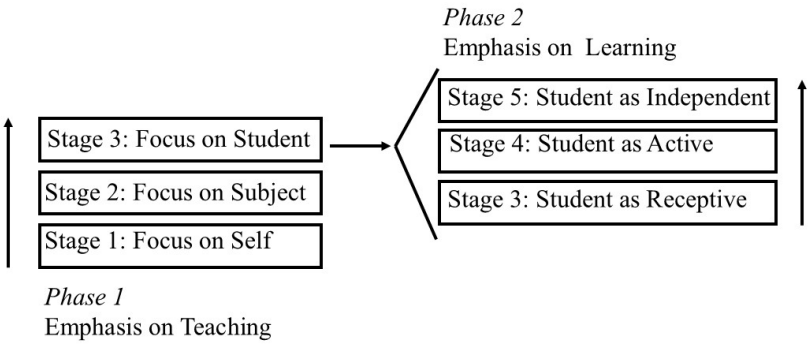

Fig. 1. Kugel´s phases of teacher development, where teachers transit from focusing on their own role in the classroom (stage 1: self) to helping students to learn on their own (stage 5: student as independent), adapted from Kugel, 1993.

The concept of the flipped classroom

In the flipped classroom, the students come prepared, and during the time with the teacher, they can receive support from fellow students and/or the teacher during activities such as problem-solving and discussions (figure 2).

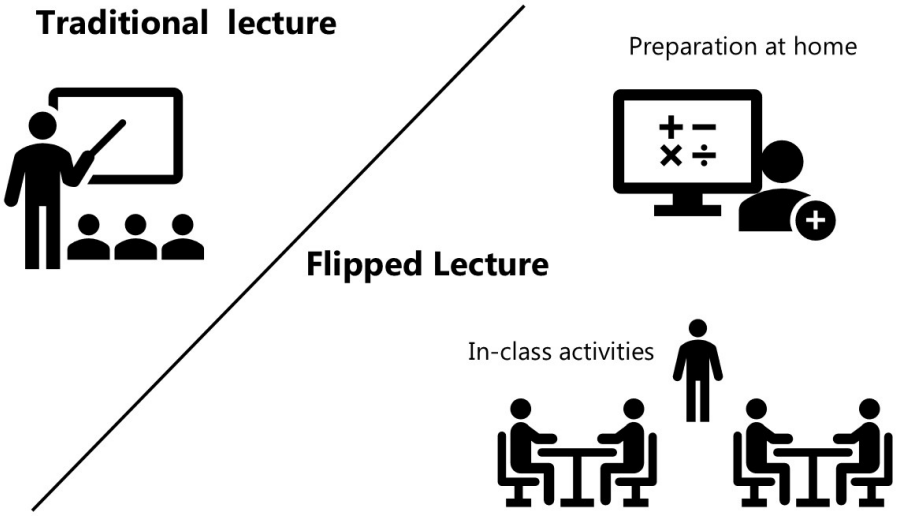

Fig. 2. The concept of a Flipped classroom approach as compared to a traditional lecture.

The in-class activities focus on active learning strategies, which are beneficial for long-term learning and the development of self-directed learning skills (Ramnanan and Pound, 2017). Moreover, according to Hamdan et al. (2013), the emphasis on students becoming the agents of their own learning rather than the object of instruction, allows the flipped learning model to enable educators to shift from teacher-driven instruction to student-centered learning. Therefore, the teacher is not the primary source of information, and as a result the students are actively involved in the knowledge construction. Teachers determine what the student should explore on their own and what they need to be taught. Although teachers take on a less visible role in a flipped classroom, they continually observe their students, provide feedback and are reflective in their practice. Hence, the time with the teacher is devoted to applying this knowledge for learning and higher order thinking tasks. Therefore, the

conventional model, where students are exposed to lectures and post lecture assignments, is flipped (Ramnanan & Pound, 2017, Hamdan et al., 2013). To engage in flipped learning, teachers should incorporate the following four pillars into their teaching practice: a flexible environment, learning culture, intentional content and professional educator (Hamdan & McKnight, 2013). A flexible learning environment encompasses both the adaptability of the physical space and the acceptance of a dynamic, sometimes noisy, and chaotic in-class atmosphere. This is in opposition to the traditional lecture, where students in general are quiet. In an auditorium, this flexibility can be particularly challenging. Additionally, it requires a shift in the learning culture, transitioning lectures from being teacher-driven to student-centered. The concept of intentional content emphasizes the maximization of in-class time to focus on teaching specific skills and concepts. This necessitates that teachers make deliberate choices about what content to teach directly and what students should explore independently. Hence, the teacher must invest time in the preparation of the out-of-class and in-class material. Finally, the professional educators, among other things, must be reflective in their practice and comfortable with controlled classroom chaos (Hamdan & McKnight, 2013).

Methodology

In this teaching intervention, intentional content for out-of-class and in-class material for two lectures (2 sessions of 45 minutes) in health legislation, were created.

Out-of-Class material

The out-of-class material were aimed at helping students acquire and test knowledge. The material consisted of quizzes and recorded video lectures.

Two quizzes were created in the student portal, Absalon. The first quiz was available four days prior to the in-class activity (pre-quiz). The second quiz was available from the end of the in-class activities and until the exam (post-quiz).

Both quizzes were available for one attempt. This was chosen to collect data on students´ knowledge before and after the lectures, using

the test results for analysis. Apart from a testing perspective, the aim of the pre-quiz was to activate the students´ prior knowledge and preconceptions of legislation, in accordance with cognitive constructivist theories, and to encourage students to self-test their prior knowledge while paying attention to key concepts in the videos. The aim of the post-quiz was to test gained competence. Both quizzes comprised 14 questions and was a combination of multiple-choice questions, ordering, true or false, and categorization, and were made using "nye Quizzer" in Absalon. The different combinations were intentionally chosen, as each option served a specific purpose in relation to the types of questions and to introduce variation. Most of the questions were similar in both quizzes, but the post-quiz featured a higher level of complexity compared to the pre-quiz.

The aim of the videos was to help students acquire new knowledge by activating their prior knowledge and introducing new concepts before the lectures. Videos were recorded using voice narration on PowerPoint presentations. The content was based on previous lectures and covered both fundamental and more advanced concepts. The video format included a small image of the teacher (myself), which was chosen to improve the teacher-student relation before the in-class activities. The total of 5 videos had an individual length of 9 – 18 minutes, which, including the pre-quiz gave a total preparation time of approximately 1 hour and 20 minutes. Additional optional material for reading was provided ("*Lovkompendiet*").

To encourage students to prepare prior to attending the lectures, two written announcements was sent via the student portal (Absalon) at the first day of the course (4 days prior the in-class activity) and at the day before the lectures. The first announcement included information regarding the purpose of flipping, and what to prepare. The second announcement was a reminder of preparation.

In-Class material

The in-class activities were designed to help students use the knowledge from the out-of-class material and to focus on progression. The lectures began with the ILO, using a picture of a medical student taking the

Hippocratic Oath to become a medical doctor. This was intended to mimic the students' future roles as medical doctors, promoting an application-oriented approach to the in-class activities, i.e. applying health legislation on real-life cases and aligning the content with the assessment (exam).

The in-class material comprised a total of 9 cases, each presented with four multiple-choice answers, which gave a mean time of 10 minutes for each case. The cases focused on applying concepts from the out-of-class material to real-life dilemmas and were more complex extensions of the questions in the pre-quiz, aligning the teaching-learning activities. The cases increased in complexity to give students a sense of progression and competence. The last case was deliberately designed with several outcomes, to make the students aware of the fact that legislation lies in the intersection of social and natural science, and thus, choices and answers can be discussed, depending on the context (Rienecker et al., 2015).

According to social constructivism, the internalization process of content, which is necessary for learning, occurs through communication and intervention, such as problem solving under teacher guidance or in collaboration with more capable peers. To promote deep learning, knowledge from the preparation was consolidated through MCQs and group discussions during the lectures, in accordance with cognitive constructivist theories (Mørcke et al., 2015). Therefore, students were given time to discuss the four answers in groups of 2-4, engaging in peer instruction. Although scattered in the auditorium, students were instructed to form groups and to stop talking when their discussions were complete, and they had decided on an answer. This lowered the noise in the auditorium and indicated, that the activities could proceed. Once all discussions were complete, voting was done using Sendsteps. Sendsteps is an online student response system that allows students to answer questions in presentations using their smartphones, enabling me as the teacher to immediately review the responses of the entire class. If 50% - 64% answered correctly, the students were asked to discuss again before voting a second time. This percentage was chosen based on the recommendations by Jan Jensen (2014). If more than 65% answered correctly, the right and wrong options were presented, giving students

instant feedback on their performance. If less than 50% answered correctly, I used the dialogue questioning technique to facilitate collaborative problem-solving before voting. The use of Sendsteps allowed me to track student engagement and performance in real-time and also provided instant feed-back for the students.

Evaluation

The evaluation was conducted as part of the final lecture at the end of the course, where students were informed about the exam. Feedback was collected from students about their experiences with the flipped learning approach to identify areas for improvement. A quantitative and qualitative evaluation approach was chosen using Sendsteps. The quantitative approach covered the student's perception of preparation and learning. Finally, an open-ended evaluation for comments and suggestions were provided for anonymous free-text feedback.

Results

A total of 200-250 students enroll in this course each semester. During this project, 71 students completed the pre-quiz, with a mean elapsed time of 4 minutes and 21 seconds. Overall, students performed well. In total, 86% (n = 61) had a score above 80% while 14% (n = 10) had a score between 70%-80%. The median score was 86%. It was not possible to get information on how many students watched the videos, but based on the answers in the evaluation, this number was at least 55 students.

At the in-class activities, the students engaged in discussions and followed instructions to be quiet when they were done. Most students participated actively in the discussion and were asking questions during the lecture and in the break, and many students approached me, even standing in lines, showing a high degree of student engagement. One student gave feedback during the lecture regarding the formulations of one of the cases, which she thought seemed unclear. Another student gave feedback, expressing her disagreement with my suggestion to discuss for a third round. At the beginning of the lecture, approximately 110 students participated in the Sendsteps voting. It is well known that enrolled students do not necessarily participate in lectures and classroom teaching,

as only the exam is mandatory. Therefore, this number of participants was anticipated. However, the number of participants who voted dropped to 66 by the end of the first lecture and remained consistent at this level for the second lecture. As some groups finished prior to others, some students went on Facebook and Messenger during the waiting time. However, both in the lectures and in the classroom teaching, which followed the in-class activities, I perceived the students as more engaged as compared to previous semesters. More students recognized me from the lectures and students seemed more active in asking questions and participating in group discussion than previous years.

The post-quiz was completed by 24 students. The mean elapsed time was a bit longer with 5 minutes and 12 seconds. More students (92%, n =22) had a score above 80%, while only 2 students had a score between 71%-80%. The median score rose to 93%. Unfortunately, it was not possible to determine whether the same students completed both the pre- and post-quizzes.

Table 1. The distribution of student votes on the question "How much did you prepare prior to the legislation lectures?"

	Answer	Percentage	Number of votes
A	I completed the quiz	10.5%	10
B	I watched the videos	9.5%	9
C	I completed the quiz and watched the videos	48.4%	46
D	I did not prepare	31.6%	30

Source: Sendstep vote results. A total of 95 students participated in the vote, with each student allowed to cast only one votes.

A total of 104 students attended the final lecture on the course where the evaluation took place, but not all attendees took part in the voting. Approximately one third of the students who took part in the voting, answered that they did not prepare prior to the lectures (Table 1).

Among those who reported preparing, 56 indicated that they took the quiz, which is fewer than the 71 students who completed the pre-quiz. A total of 84 students answered the second question "to what degree did the combination of preparation and discussion in the lectures, helped you understand the theoretical knowledge of health law?" (Table 2). Given that more students answered this question (n = 84) than the number who indicated they had prepared (n = 65), the results are challenging to interpret, as it is difficult for the students to provide a clear answer to this question, if they did not prepare prior to the lectures. Of the 84 answers, around forty percent were neutral (n = 32), and half (n = 44) were positive and answered, "to a high degree" or "a very high degree".

Table 2. The distribution of student votes on the question "To what degree did the combination of preparation and discussion in the lectures, helped you understand the theoretical knowledge of health law?"

	Answer	Percentage	Number of votes
A	Not at all	2.4%	2
B	To a low degree	7.1%	6
C	To some degree	38.1%	32
D	To a high degree	40.5%	34
E	To a very high degree	11.9%	10

Source: Sendstep vote results. A total of 84 students participated in the vote, with each student allowed to cast only one votes.

The qualitative comments ranged from positive comments regarding both the video lectures and the cases, e.g. that preparation could be done at the students' own pace, to more negative comments regarding a too slow speed of both the video lectures and the group discussions. Some students were expecting a traditional lecture and were unaware of the need to prepare prior to the in-class activities, while some students found the content confusing. Around half of the comments were positive. A selection of the student comments is shown below (translated into

English).

- "Good with cases, as the legal material could be read at home."
- "It was nice with cases – it was possible to follow along without having prepaired beforehand."
- "I thought it worked poorly. I don't think something should be called a lecture and then require us to talk ourselves; that's Student-Activating Teaching. Additionally, there was a lot of preparation."
- "The case discussions went too slowly. We had finished discussing and needed some answers. Nice to be able to watch the videos again."
- "Very good, it works well to delve into the theory at one's own pace and also re-watch the videos."
- "I think it was great with cases, it made it more exciting and easier to remember."
- "Cases are more engaging, which is good. Perhaps there could be a bit more information regarding the preparation."

Discussion

The flipped classroom approach is particularly useful for teaching difficult concepts that require significant time to interpret and master (Marsh & Gurski, 2016). Since health legislation lies at the intersection between social and natural science, results, conditions and choices can be discussed and questioned (Rienecker et al, 2015). This makes the legislation module an obvious choice for a flipped learning approach. However, transitioning from teacher-driven to student-driven lectures requires students to come prepared (Hamdan & McKnight, 2013). The flipped learning approach emphasizes student responsibility for their learning (Luscombe & Montgomery, 2016; Bashir & Hamid, 2022). With prior knowledge of the topic, students can engage in deeper discussions, which not only makes them more engaged but also enhances their interest in the material, encouraging critical thinking and effective application of knowledge (Bashir & Hamid, 2022). In the current setting, approximately one third of the students who participated in the evaluation expressed that they had not prepared. This may be due to the announcement arriving just four days before the lecture or the traditional learning culture of teacher-centered lectures, where a lecture is merely the transmission of information (Luscombe & Montgomery, 2016), leading students to believe they do not need to prepare for lectures. The introduction of a

flipped approach in lectures can be seen as a breach of the didactic contract between the teacher and the students as described by Brousseau (2002). This shift challenges the implicit expectation that lectures are primarily teacher driven sessions with passive student participation. This perception was reflected in some of the student comments, which described the lectures as resembling a student-activating classroom setting, indirectly commenting on this breach of contract. Moreover, being a smaller module within a larger course presents additional challenges to implementing a flipped approach, as it contrasts with the traditional teaching format used in the other course lectures. Therefore, it may be challenging to increase the number of students who prepare for the lectures, and it must be anticipated that a significant portion of students will come unprepared. To ensure that unprepared students are not excluded from learning, the relevant pages in the already available written material ("*Lovkompendiet"*) can be integrated as in-class content to support group discussions.

In the current flipped classroom approach, learning was based on group discussions to foster peer-instruction. Groups of 2-4 students were chosen. According to the literature, groups of four achieve greater learning because students in these group sizes are more willing to discuss conflicting perspectives (DeLozier & Rhodes, 2018). Groups of four also increase the chance that a group comprise a student who prepared. Hence, in future lectures, I will try to form groups of four to test if this influences students' discussions.

As intentional content is one of the four pillars of flipped learning (Hamdan et al., 2013), the in-class material was solely based on real-life cases that applied the pre-class content with increasing complexity to foster a sense of progression and competence. As is common in health scientific programs, I focused strongly on the practical application of the content (Reinecker et al, 2015), also known as an application-oriented approach. The real-life cases required students to analyze legal concepts introduced in the out-of-class material. This approach was intended to promote higher order thinking and enhance deeper understanding, encouraging deeper learning (Hamdan et al., 2013). Voting could not be done until all groups had finished discussing. This was deliberately chosen to ensure that students had the necessary information for

meaningful participation and to avoid rushing the discussions, as they were a central element of the learning process. However, this may have led some students to feel that the pace was too slow. The in-class material was focused on a constructivist approach to learning, ensuring that students worked actively with the content to construct their own understanding and actively process what needs to be learned. Using the didactical triangle, the students and content were at the center, and I, as the teacher, had a facilitating role rather than the role of a transmitter. Ideally, the transmission of knowledge was done prior to the lecture using the out-of-class material. In class, the focus was to activate the students with the objective of promoting deep learning as opposed to surface learning, which is usually the result of a traditional lecture (Dahl & Troelsen, 2015). Although not all students had prepared, it was my experience that the students were actively engaged in the group discussions and, in most cases, selected the correct answer. Following Jan Jensen's recommendations (Jensen, 2014), groups were instructed to re-discuss the question if the correct answer was chosen by 50%-65% of participants. According to the free-text evaluations, some students found this frustrating, likely due to a lack of preparation, which left them without the necessary tools to contribute meaningfully. In future teaching, the greater focus on including unprepared students should help reduce feelings of frustration.

Another pillar of flipped learning is a flexible environment (Hamdan et al., 2013), including the physical space. In the in-class activities, the proximity of students to the teacher and each other is crucial for group formation, discussions, and teacher engagement in student discussions. Although the traditional auditorium setup encourages the teacher to be the transmitter of content, it can be made somewhat flexible. In the current setting, students were scattered throughout the auditorium, which challenged proximity and group formation, diminishing both the teacher-student and student-student interactions and potentially encouraging passiveness among some students. Because of the physical distance between the groups and myself, it was difficult for me to engage in the group discussions. This made it more challenging for me to observe the students, engage in their discussion and to provide feedback. This issue can be addressed, by instructing students to fill the seats from the

front row backwards, either at the beginning of the lecture or beforehand, which I will implement in future settings, knowing that this may introduce some resistance, as some students feel more comfortable sitting in the back. However, this minor change could hypothetically have a significant positive effect on the learning outcome and enhance my facilitating role as the teacher.

Increasing student engagement is one way to enhance the quality of learning and improve students´ knowledge (Prince, 2004). Engagement can be evaluated, not only by the number of students who prepared but also by the extent of student participation during the in-class activities. In this project, the number of students participating in the Sendsteps voting during the in-class activities dropped from 110 to 65. Possible reasons for this drop may include groups becoming more consolidated and not everyone feeling the need to vote. However, the repetitive nature of the high number of cases, including voting, may have made the students less active. One way to introduce more student involvement in the future could be to include hand-raising for quick visual engagement, adding variation to the voting process. Additionally, the repetition of cases, which follow the same teaching format throughout the lectures, could benefit from more variation, e.g. by introducing examples or theoretic slides between a series of cases. Moving some theory from the preparation phase to the lectures could also reduce the cognitive load in the videos and include students who did not prepare. Another option could be to reduce the number and increase the complexity of the cases. While some alterations can be planned before the in-class activities, others require a professional educator who can reflect-in-action (Troelsen & Tofteskov, 2015) and act upon this reflection during the in-class activity. In this project, the group answers to the multiple-choice questions in connection to the group discussions gave both the students and I direct feedback on the student engagement and understanding of concepts in real time. In my experience, students seemed more engaged in the lectures and the following classroom teaching, than previous semesters, which may indicate that the cases and group discussions had a positive effect on the learning.

The out-of-class and in-class activities used in this project are common activities in flipped learning, which according to the literature

are valuable and highly satisfying educational activities (Ramnanan & Pound, 2017). However, video lectures themselves do not directly affect learning (DeLozier & Rhodes, 2017); they were used to free up time for active learning during in-class activity. Videos should be engaging and accessible. According to Jan Jensen (2014), videos longer than 7 minutes are not manageable and risk causing cognitive overload, which I will be more mindful of in the future. Reducing cognitive overload can be achieved by dividing long videos into smaller sections and naming them accordingly. The required workload was perhaps too demanding for the average student, which it should not be to ensure students self-efficacy and motivation. In future teaching, I will reduce the preparation time by introducing some of the content in the in-class-material, which will also serve to create more variation and inclusion of unprepared students. More importantly, I will ensure that students are informed about the need to prepare for the lecture and clearly communicate what they can expect, in order to address the breach in the didactic contract. Moreover, the already available written material ("*Lovkompendiet*") can serve as a resource for students who have not prepared, ensuring that a lack of preparation does not lead to passivity and enabling these students to participate actively. Although the videos were too long, recorded video lectures provide students with the flexibility to learn at their own pace and the opportunity to review and repeat the content (Bashir & Hamid, 2022). This benefit was also reflected upon in the free-text evaluation.

Quizzes were, apart from the testing aspect, used for introducing concepts and providing feedback. Only a few students completed the post-quiz, so it did not fulfill its purpose. In the future, I will introduce the post-quiz at the end of the lecture to help students feel a sense if gained competence before leaving the in-class activities. This will also serve as motivation and may alleviate any feelings of confusion, as reported by a student. Furthermore, the pre-quiz will be available for multiple attempts to increase the learning potential.

Conclusion

In this project, I replaced the conventional teacher-centered lectures with a student-centered approach using flipped learning to encourage deep

learning, aligning with current trends in higher education. Introducing the flipped approach represents a breach of the didactic contract regarding the typical teacher-driven lecture, and this may be why it was difficult to get students to come prepared. Although students seemed engaged in group discussions and approximately half of their comments were positive about the flipped approach, it was not possible to fully evaluate whether the aim of enhancing their learning was achieved. Moving forward, the focus should be on clearly informing students about what to expect and how to prepare, introducing fewer but more complex cases, and providing unprepared students with tools to participate actively in the group discussions, with the aim to enhance learning outcomes.

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