Case-based teaching and learning: Attention points towards improving student engagement and participation

Katja Maria Sahlgren Bendtsen

Department of Veterinary and Animal Sciences
University of Copenhagen

Project context and motivation

Veterinary Anatomy and Physiology offered at Copenhagen University (SVEB13019U + SVEB13020U) is a combined bachelor course, where organ systems are covered in parallel from a physiological and anatomical perspective with summative assessment by two separate written/practical exams. The intended learning outcomes (ILOs) are covered in modules ending with a specific case and the teaching is carried out by two teachers in collaboration from Anatomy and Physiology, respectively. This teaching is centered on a real-life clinical case, relevant to the future work life of veterinarians. The case description and questions are given in advance for the students to prepare. The cases are reused every year, as it takes time to find and develop suitable cases with wide coverage in terms of the ILOs for the particular module. Although the students are instructed and expected to come prepared and be active during the three-hour allocated case teaching session, there is no official consensus on how to facilitate this teaching optimally. The reality is that the teachers expect more preparation and student engagement than the students provide. The ILOs for a module case are officially the same as for the entire module itself and is intended as an opportunity of repetition and contextualization. However, the complicated interdisciplinary scenario of a clinical case often touches upon aspects not within the ILOs of the relevant module or the course as such.

The future new veterinary curriculum is being modified with increased focus on case-based teaching. In addition, there have been suggestions to move some of the ILOs from lectures and exercises into

case-based teaching. Therefore, I was motivated to examine this further by identifying incongruences in order to provide some reflections and discussions of 1) how the students experience case-based teaching in Veterinary Anatomy and Physiology and 2) which considerations should be made to improve congruence, when planning and facilitating case-based teaching.

Didactical background

Teaching and learning is a complex phenomenon, not only defined by the transfer of knowledge between teacher and student. Good (university) teaching focuses on the students' perspective of learning (Rienecker L. et al. 2015). Learning Veterinary Anatomy and Physiology requires a high degree of memorization of details and terms before confidence and deeper understanding of general functions and connections forms into an applicable overview (as is the case for most sciences). This is a frustrating process for the students, as the definition of required level of detail is not always clear, despite available lists of ILOs. Even though retention of details to some degree is expected and assessed in the final exams, the acquired competence from the course relevant to future studies and work life is the ability to apply a general anatomical and functional understanding in pathological and clinical settings. Case-based teaching is a form of problem-based teaching and learning activity (TLA) (Dolmans et al. 1997), where there is opportunity to put details into greater context and real-world applications, achieving a higher level of abstraction (Krogh L. et al. 2015). In turn, case-based teaching can provide congruence for the students on different levels. Congruence between the course material and the case/questions is imperative if the students are expected to prepare and are expected to recollect and apply ILOs from previous lectures. Congruence between the overall course description and expected competencies and the case is important in terms of the case being meaningful for the students to engage in. Congruence as a term is an expansion of the teaching approach of constructive alignment (Hounsel & Hounsel 2007), which ensures that TLAs and assessments are aligned with ILOs in a student-centered way (Biggs J. 2014).

Another important aspect is the alignment of expectations between students and teachers. TLAs are carried out in a common mutual understanding of what is expected of the learning and teaching environment. Depending on the TLA, the inherent expectation varies. For a lecture, there has at least historically been a common understanding that the teacher does most of the talking, perhaps with addition of plenary discussions or quizzes. For a practical exercise, there is a common understanding of the students doing the work with the teacher being available for questions and assistance. For case-based teaching, the common understanding or expectations are perhaps more elusive and depend on the particular science. Naturally, explicit prior planning, communication, and agreement on the scenario in the classroom increases the likelihood of achievement of the ILOs. When we as teachers of Veterinary Anatomy and Physiology expect the students to come prepared for a case discussion, we inherently also to some degree expect the teaching to be driven by the students' input. However, when the students mainly appear as underprepared or unwilling to present, this calls for a renegotiation of the "didactical contract" (Brousseau & Warfield 2014).

In relation to the didactical contract of the learning environment, another aspect to consider is the different backgrounds and varying academic starting points of the students in combination with the social environment. This is a constructivist view on learning, where the student's new knowledge is based on the existing knowledge base of that particular student, and the individual student's

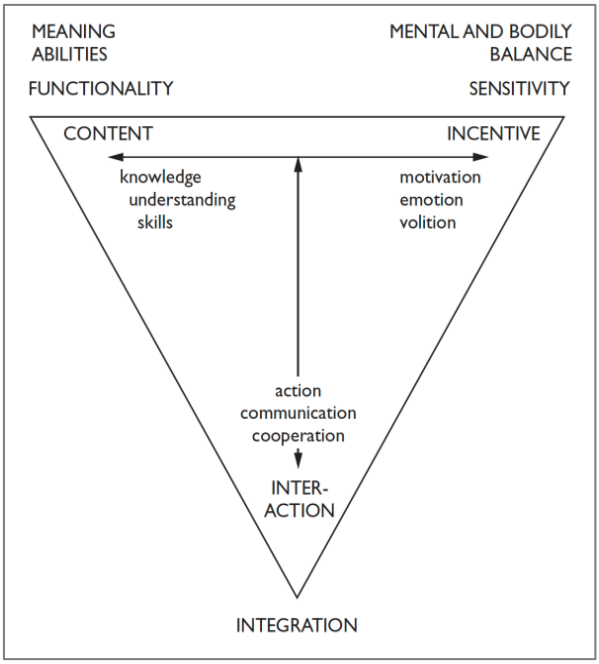

Fig. 1. Illeris, K. (2018). Contemporary Theories of Learning. Routledge

knowledge is thereby "constructed" based on personal interpretation in combination with the surroundings (Dolin J. 2015). Even though students may be willing and motivated to participate, they may not feel confident in a plenary setting, either due to academic, psychological, or social awareness. It is important to be aware of these other aspects of the learning environment (illustrated in Figure 1), as these influence the learning significantly.

Methodology

Module 1 of Veterinary Anatomy and Physiology 2 (SVEB13020U) covers the Heart, Respiratory System, Circulation, and Lymphatic system. I was responsible for the anatomy part of the Module 1 case in 2022 and 2023, which was the basis of this assignment. The case is about Monti the dog, which is presented with a range of symptoms relating to Module 1 ILOs. The clinical case with data on the dog was presented in detail in the beginning of the session, before a plenary discussion of the questions was facilitated by a colleague from Physiology and me.

1) 2022 case-based teaching: In 2022, we more or less reused the case questions and the teaching strategy from previous years, where anatomical and physiological questions were separated. The students were encouraged to prepare and participate. After the case-based teaching, we evaluated the teaching from our perspectives by discussing and suggesting improvements for 2023.
2) 2023 case-based teaching: We made some changes to the case by blending the questions between anatomy and physiology, in order to facilitate more flow and interdisciplinary context. In turn, to avoid the case-based teaching turning into a teacher-focused lecture, we moved away from using a PowerPoint presentation. Instead, we attempted to encourage discussions and interaction by using the chalkboard.
3) Students' expectations and experiences evaluated by questionnaires: In order to find out, why there was a misalignment in preparation and participation expectations between teachers and students in both 2022 and 2023, I sent out a short questionnaire (in Danish) as an online Absalon quiz before and after the Module 1 case in 2023. The

questions were a combination of multiple choice and open questions (Table 1).

Table 1. Questions about the students' expectations and experience asked in an Absalon quiz

Questions asked **before** the Module 1 case teaching		
1. Describe your expectations of the Module 1 case		
2. How did you prepare?	*I have read the case description*	
	I have answered a couple of questions	
	I have answered almost every question	
	I did not prepare	
	I have discussed the case with my study partner or group	
3. Are you worried about answering questions and discussing in a plenary setting?	*Yes*	*No*
4. If yes, describe why:		
5. Do you feel sufficiently equipped for the Module 1 case discussion based on lectures and perhaps your preparations?	*Yes*	*No*
Questions asked **after** the Module 1 case teaching		
1. Did the Module 1 case meet your expectations? Suggest 2 or more positive aspects or experiences		
2. Do you have suggestions for improvements?		
3. Did you feel confident in actively participating (put up your hand and provide input)	*Yes*	*No*
4. What can be improved in order to help you participate more actively in the Module case discussion?		

Results

Teachers' perspectives on Module 1 case-based teaching in 2022 versus 2023

The questions for the Module 1 case in 2022 were separated in anatomy and physiology questions. Consequently, my physiology colleague and I had two more or less separate sessions each. For the anatomy questions and answers, I used a PowerPoint presentation, as I felt the illustrations and common reference points would be beneficial. My colleague used the chalkboard for formulas to guide the physiology discussions. Before each question were discussed, the students were given 5 minutes to discuss

with peers. Overall, we felt that the Module 1 case of 2022 went well, but needed some adjustments. For the 2023 Module 1 case, we changed the order of questions to be more integrated between anatomy and physiology, to avoid separate sessions and increase interdisciplinary discussions. For the anatomy part, I tried out not using PowerPoint at all and used chalkboard drawings to increase activity and oral discussion instead of lecturing. However, this did not function very well. In anatomy, it is beneficial to have a common, well-illustrated reference point for repetition and discussion of the ILOs in relation to the case questions. It was my intention to have the students volunteer to draw on the board, but this was not successful. As the students did not participate as vividly as hoped, the discussions were mostly teacher-centered and quickly over. Another backfire was also, that by the lack of PowerPoint presentation, no correct answer to the questions were provided clearly, other than communicated by discussion. In turn, as the questions were more linked compared to last year, the students were not consistently given preparation time before each question, decreasing the active participation. Consequently, our time management was off with a lot of time to spare in the end, which was filled out with improvised lecturing.

Students' experience of preparation and active participation

The questionnaires (Table 1) were sent out in close proximity before and after the teaching in 2023. Approx. 1/3 of the students (50 students) responded before the case-based teaching and 1/6 after the teaching (25 students). Before the teaching were to take place, I asked the students if they felt sufficiently prepared to participate actively, and some interesting contradictions were evident. If we disregard the students not answering the question (8/50 students), 17% (7/42) answered that they did not prepare, while 83% (35/42) had engaged in some form of preparation (Fig. 2). 17% (7/41 responders) did not feel sufficiently equipped from previous teaching, while 83% (34/41 responders) did feel sufficiently equipped. However, 68% (29/43 responders) still felt worried about active participation in a plenary setting. After the teaching session, 56% (14/25) felt that they had been comfortable in active participation, while 44% (11/25) had not (Figure 2).

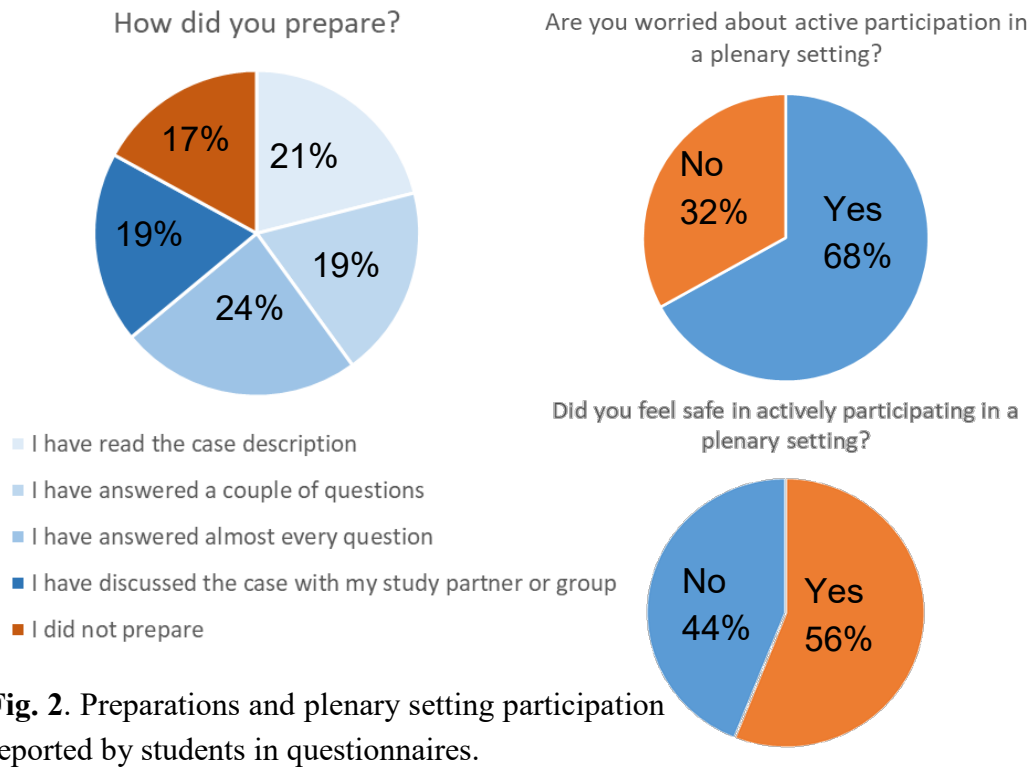

Fig. 2. Preparations and plenary setting participation reported by students in questionnaires.

A number of students commented on the lack of preparation as a time issue, exemplified here:

> "There were big expectations of the degree of preparation – with the many long days we have at the moment, it is simply not realistic to achieve

Some of the reasons given by the students feeling worried, despite feeling prepared were:

> "It is a relatively large group of people that I have to answer in front of, which is crossing my boundary, if I do not feel sure about my answer

> "I am worried about appearing stupid

> "I personally do not feel particularly comfortable in this kind of setting. However, I like discussing in smaller groups

Some of the suggestions or comments given by the students on how to increase participation were:

> "Smaller groups, perhaps dividing the students in two separate teaching sessions

> "It was great when we were given a couple of minutes to discuss with our peers – then a better overview was formed including a better answer to provide in plenum

> "Less expectations of our preparations and knowledge in advance

> "You could provide longer preparation time for the questions during the session. We do not have the time to prepare so much before the case teaching. It would be nice with a list of which ILOs belongs to each case question

Students' expectations of learning outcomes

Based on the questionnaire, some of the students' expectations of the Module 1 case were aligned with the overall didactic purpose of case-based teaching, as summarized by these student comments:

> "I expect to learn more about how to apply what we have learned in the lectures

> "I expect to be able to tie a knot on the topics we learned about in the lectures. I also hope to get some repetition on some of the hard stuff, and understand better, where our focus should be

The expectations of the case-based teaching session as TLA and the learning environment were mixed. Some had positive expectations:

> "I expect the questions to be a discussion between students and teachers. I hope to gain a better understanding by hearing the answers of other students and clarifying answers from the teachers

> "A good walk-through of the case with longer description of difficult questions, so I gain a better understanding of the topic

Others unfortunately had less positive expectations based on prior experiences:

> "I fear that it will go very fast and that it will be hard to follow, if I want to write notes

> "I expect to gain very little from the case. In all the other cases, except one, the teachers have denied handing out their presentation, so it is very hard to take notes. Besides that, it goes way too fast. The answers from other students are not repeated, so it is very difficult to hear if your own suggestion to an answer was correct or not. So based on my experience, I do not expect to gain very much

The expectations of the teachers providing a correct answer to the case questions were abundant in the questionnaire comments both before and after the teaching, exemplified by these quotes:

> "I expect to get a clear and thorough examination of each question, so it is easy for me to supplement the text, I already wrote

> "I personally felt that some of the questions lacked a final correct answer

Students experience of the case-based teaching

After the teaching session, the students were asked to comment on their experience of the learning activity. Some had a positive experience:

> "I got a better overview of the terms and connections. Great case

> "It was a really good case that connects everything, with a lot of the ILOs in! It is great to be able to connect all the theory on a practical example. It is nice to go through it all again

> "I think that the connection between anatomy and physiology was really good in this case. Apart from that, it worked well, when we were given a couple of minutes to discuss with our peers before a plenary discussion. The presentation of the case itself was also

> really good. It is easier for me to understand a topic, when it gets related to the reality

Others had a more negative experience with suggestions for improvement:

> ”I need the teachers to articulate that people are loud and disturbing despite the scheduled teaching session. I gain a lot from the module case teaching, and I think it is a shame, that it is ruined by not everyone agreeing

> “Provide a clear summary of which questions is being discussed and the most important points of each question. It should be made clear, when we are moving on to the next question, so it is not just one fluent discussion

Discussion

The spectrum of disciplines and sciences covered in the Veterinary Science education as well as in any other medical education prepare the students to be life-long learners and give them the ability to gain knowledge from different sources and apply it in a rapidly changing society (Cavalieri 2009). As a problem-based TLA, case-based learning prompts the students to use their competences in an analytical and applicable way to achieve a higher level of understanding (Krogh L. et al. 2015). However, it is clear that in order to be a successful learning experience, a number of misalignments and incongruences (Hounsel & Hounsel 2007), particularly between teacher and student perceptions of the “didactical contract”, should be avoided. Based on the students’ feedback and peer-discussions, the main incongruences identified in our case-based teaching are presented in Table 2.

Table 2. Identified incongruences in our case-based teaching

Aspects	Optimal/expected scenario	Improvement points
ILOs:	Course/module ILOs assessed in the final exam are repeated in case-based teaching	New ILOs not previously taught appear in the case
Validation from teachers:	Correct answers provided and clear transitions to next questions	Open-ended discussions

	PowerPoint for a common reference point (images in anatomy)	Using the chalkboard instead of PowerPoint
Student preparation:	Students come prepared in a way that makes them able to engage and drive discussions	Students feel time-restricted and unable to prepare to expected standards
Students activation:	Students actively engage in answering and discussing in plenum	Students feel uncomfortable engaging in a large plenary setting
Planning and time management of teachers:	Detailed plan and timing with scheduled in-session preparation time for the students, quizzes etc.	Discussions and questions lead the teaching session

Awareness of the potential of case-based learning in a broader context could be useful to develop how the teaching could be facilitated in the future. John Cavalieri describes in detail how curriculum integration including case-based, problem-solving TLAs has been developed and expanded for the veterinary bachelor education at the James Cook University (Cavalieri 2009). The approach is to continue to develop TLAs that "reinforce knowledge across disciplines" and are "designed to help students see connections among disciplines and topics".

There is a danger of repeating lectures and performing long explanations, if the students are not engaging in the discussions during a case-based session. If so, we should change the circumstances of the teaching environment to help increase their engagement. Teaching-learning situations are affected by social dynamics (Prince 2004). The active engagement and thereby the learning of the students is affected by how they believe to be perceived by their peers as well as by the teachers. This is likely a universal circumstance, which has to be considered particularly in TLAs such as case-based teaching, where we ask the students to "expose" themselves and their knowledge. In light of this, considerations about the preparation of the students is beneficial. It is evident from the feedback that it is important to provide scheduled preparation time, either as a part of the teaching session or before it takes place. Students have individual needs and requirements for preparation, and even if they are prompted to prepare, it is not always clear, what forms the preparation strategy of university students (Herrmann & Bager-Elsborg 2018). The difficulty is that in Veterinary Anatomy and

Physiology it is the topics of the ongoing module, which are applied in the module case. Of course, the students need to learn about the ILOs before they can be expected to apply them in a case setting. Hence, the expectations of the students' knowledge base should likely be somewhat reduced, as they just only learned about the topics relevant for the case. This was in fact pinpointed by a student comment in the questionnaire:

> "You must remember that we have only just been introduced to the subject and the many terms and that we are not yet able to use them alternately and put them in a greater perspective

This is a disadvantage of case-based learning in a broader curriculum integrative sense, as problem-solving and application require a higher level of cognition compared to just recalling facts (Cavalieri 2009). An idea could be to push the Module cases forward, independent of the Module itself, as to allow for retention time of the ILOs and to use the case as a repetition after moving on to other organ systems. At Nottingham School of Medicine, they examined if their teaching by similar body-system-based modules had the intended pedagogical function of aligning theory, context, and practice, or instead lead to fragmentation of subject areas for the students (Foster 2015). They found that the integrated curriculum approach was successful and the students were in fact able to "smoothly contextualize subject based disciplines within the larger system-based modules" (Foster 2015).

Therefore, it is important to discuss the facilitation of case-based teaching, including which teaching materials are optimal for case-based teaching and learning in Anatomy and Physiology and how to structure the use of them between collaborating teachers. Dolmans and colleagues outline seven principles of case-based teaching in order for a case to be of such a quality as to drive student learning (Dolmans et al. 1997). The principles states that a good case should take into account *the students' prior knowledge, have questions or cues to facilitate discussion, be relevant to future work-life, facilitate integration of basic knowledge and context, encourage students to self-learn and enhance interest, and be aligned with the course/faculty objectives* (Dolmans et al. 1997). These areas fit well with the incongruences identified from the students'

feedback. Regarding teaching materials, teaching anatomy definitely benefits from PowerPoints with figures or drawings on the board. In turn, the students suggested using quizzes, as it activates more students - especially because this takes into account different participation preferences/comfortabilities. This would also provide the teachers with an assessment and feedback opportunity, depending on the ILOs: Have the students in general perceived the larger aspects of the module, can they connect the ILOs to the case questions, and are they using the correct terms and vocabulary when answering the questions? The teachers can then adjust the facilitation of the case discussions accordingly.

Recommended attention points for future planning of case-based teaching based on students' experiences and teachers' perspectives

1. Smaller groups
2. Clarity about the ILOs
3. Validation of correct answers or of when a discussion is closed
4. Allocated preparation time before or during the teaching session
5. Realistic expectations of students' higher-order knowledge
6. Incorporate more clues and hints for the questions
7. Attention on the learning environment in a plenary setting (noise, repetition)
8. Incorporate electronic quizzes or anonymous answering options

Concluding reflections

It is evident from the questionnaires that there were conflicting expectations and experiences of the case-based teaching among the students. It was interesting that the comments and suggestions from the students were so diverse. The opinions and perception of the students changes from year to year, and as a teacher you have to maintain a solid foundation of teaching materials and methods, you feel comfortable with, while still being open to improvements. What I have learned is to not take negative comments or failure in teaching strategy too personal, but try to improve and balance what works for most of the students with suggested changes relevant for the learning environment and the ILOs.

For my own future teaching, this project has definitely increased my own awareness of the complexity of (case-based) student-centered teaching and the importance of alignments of expectations and particularly, the role we as teachers play as *learning environment facilitators*. The recommended attention points will be discussed further with my colleagues and will be part of improvements of our case-based teaching.

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