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Improving teaching-learning activities for a flipped-classroom course

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Introduction

My main focus for this teaching intervention was to make the students DO - think, write, communicate and reflect over the topic, methods, results and perspectives of the original, scientific papers read in the master-level colloquia-based course "Principal Subjects in Immunology and Metabolism" at the Department of Biology at University of Copenhagen.

The intended learning objectives of the course are to gain knowledge about immunology and metabolism but also to obtain skills in reading original scientific literature critically, to combine gained knowledge to new ideas, to be able to present and defend a paper and to sum up a topic and write it down in a review-like assignment.

In this assignment I deal only with Module 1 of this course, which course runs over 3 Modules, where Module 1 and 2 revolve around paper reading and presentation. The gained knowledge and skills are put to use in Module 3, where the students have to pick a topic, write a review, present it and defend it – no classes, just individual work. TLA's, with increasing difficulty, for improving students' writing skills (write an abstract, a popular scientific assay, a summary of a paper) will be introduced in Module 2.

In Module 1 and 2 the course consists of 3 hours of class-room teaching, 1 guidance hour and 22 hours of homework per week. Students are given 2 papers for each week with the purpose to read them between classes and then be able to ask questions and have a discussion about them during class. Each student is to present one paper (15 min PowerPoint presentation) to the class at least once during the course.

Structuring 22 hours of homework dealing with high-ranking scientific papers is not an easy task. Neither is being critical towards published papers written by experts in the field or to fulfil the rather elusive demands for passing the course – asking questions, have a discussion, participating actively.

Accordingly, the level of deep understanding of the papers, the methods, results and impact can be rather low. For example, after a presentation of a paper, the presenting student was asked to explain in his own words what the papers was about - he was not able to say anything!

Theory

To reach the higher levels of learning as described in Blooms taxonomy I base my intervention on the method of Constructive Alignment described by Biggs & Tang (2011*a*).

The idea is, by aligning the Intended Learning Objectives (ILOs) with appropriate Teaching Learning Activities (TLAs) and Assessment Tasks (ATs), students will work and learn on higher levels of Blooms taxonomy such as to combine and integrate knowledge, reflect and judge validity of results and assemble and design hypothetical experiments. An important part of this process is changing the role of the teacher as an organ of knowledge transfer to a person facilitating and guiding the students to reach these higher levels of deep learning.

The online-based collaborative learning-environment is a rather complex "creature", where many considerations about both didactical and technical character has to be carefully considered - as illustrated in the didactical holistic model for planning internet-based teaching presented by Christensen and Søndergaard and shown in Figure 18.1. This model consists of the classical didactical triangle showing the interaction between teacher, student and the topic – and on top of that, another triangle with the interaction between the overall pedagogical, technological and organizational framework of the course.

Of specific considerations for the teaching intervention presented in this assignment was the choice of online platform (technology) for the course. First of all, it is important that the online platform is introduced in order to facilitate deeper learning; in this case to introduce collaborative learning between classes. Furthermore, the online tools have to be well suited for the purpose, in this case annotation of pdf-files and sharing of documents,

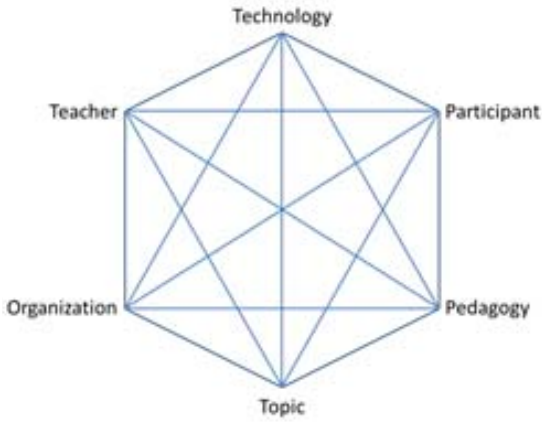

Fig. 18.1. Didactical model for planning of internet-based teaching (redrawn from Christensen & Søndergaard (2009)

and not create (too many) problems or frustrations for either students or teachers.

Another consideration was the role of the teacher in the online part of the course, the collaborative annotation. The visibility and presence of the teacher is obvious in classical face-to-face class teaching, and must not seem absent when doing internet-based teaching. The goal of this teaching intervention was for the teachers to facilitate reading of the papers by posing questions in the text and acting to guide answers in the right direction and validating correct answers.

Finally, inspired by the didactical framework for internet-based collaborative learning described by Agertoft et al. (2003), the role of the students was considered. The goal was to make the students feel part of a group of people who jointly are constructing a common knowledge about the topic by answering questions from teachers, to have questions answered by other students and answering questions from other students in a dialogical process. Thus giving the students both responsibilities for their own learning and for the group as a whole; ideally obtaining the feeling of participating in a common learning process. This goal can be reached when students (and teachers) are communicating through dialogue and conversation with a high degree of participation as shown in Figure 18.2.

The goal with this teaching intervention was to get students to place themselves in the quadrant of Conversation, by writing answers, responses and collaborating in finding the correct answer, characterized by a high degree of participation and low degree objectiveness. This will increase deeper learning for most students as described by Gynther (2005) and

Fig. 18.2. Model of communicative of practice (redrawn from Gynther (2005))

Christensen & Søndergaard (2009). However, some students might deliberately choose the "lurking" strategy, where they seem to passively be observing without participating and learning, but this student-type might rather be gaining insight from own reflections (Christensen & Søndergaard 2009) and the course should leave room for these students as well.

Methods

In this teaching intervention I focus on improving the structure of the weekly scheduled 22 hours of homework, where a lot of time is spend by the students with very little learning outcome as results. Thus the purpose of this University Pedagogy Project is to improve the between-class TLA's for this course to make the students better meet the ILO's.

During teaching in the fall of 2014 I introduced the following new TLA's:

Introduction of between-class assignments the students have to present class

This activity serves to make the students think about what they read in another way and learn from different ways of solving a problem by other students. In the beginning the assignments will be easy (3 things you googled

while reading the paper), with increasing difficulty corresponding to the gained skills (Make a hypothesis of the immunological pathways linking the gut bacteria to low grade inflammation in adipose tissue).

Purpose:

- To give more structure between classes.
- To help the students relate to the paper, think creatively, differently and to use gained knowledge in a new way.
- To facilitate peer-teaching. Students can get inspired by how other students chose to solve an assignment.

Embedding questions from the teachers into the papers, which are to be answered while reading

Some questions serve to guide the students in how to read a scientific research paper, by emphasizing small things, such as a statement, a result, a method (What is an SPF-mouse? What does an increase in fasting insulin, but not fasting glucose, indicate in terms of insulin sensitivity and glucose tolerance?). Some questions serve to make the students think about the paper they are reading, the results presented to them, such as to assess whether or not a result I reliable, a specific method is the best suited for the purpose or to judge the validity of conclusions presented in the paper (Look at the figure – are you convinced that NF-kB is activated? What are the pros and cons of this method?).

Purpose:

- To help identify what is important, and not so important, in a paper.
- By answering the embedded questions from the teacher, students can assess their own understanding of the paper.
- To facilitate critical reading of the paper, by asking detailed questions about the coherence and validity of the results presented and the methods used in the papers.
- To guide the reading of the papers a critical, scientific direction.

Introduction of an online platform for interaction with teachers and other students between classes

Here the students not only have access to all the papers, but also the possibility to interact with each other and the teacher between classes. Students

can ask questions to each other or the teachers, answer questions from other students before the teachers does and comment on each other's answers.

Purpose:

- Students have an online, social "room" for studying while not in the classroom.
- To facilitate peer-teaching. Students can help each other answer the embedded questions; they can discuss the answers and pose new questions.
- The teacher can assess which students are active (the course is passed by active participation)
- The teacher can see where the students have conceptual problems and put emphasis on that in class (and leave out the easy bits)

Implementation

The working methods and purpose of the interventions were carefully introduced in the very first lesson of the course, with emphasis on the skills the students are supposed to gain during the course, how they can achieve this by using the tools and activities introduced and the rules for active participation and passing the course.

participation and passing the course. Google Drive was introduced as a common platform for all the activities on the course, both during and between classes. One week before the course the students were asked to create a gmail-account in order for them to get access to the course material. The course folder on Google Drive is used as a common course platform for sharing information from the teachers, such as the papers to read, a detailed plan for the course with a list of papers to read each week, the topic they cover and the between-class assignment. Furthermore, the course folder was also used to share the student presentations, secondary literature from teachers or students, and to deliver assignments.

Google Drive is a very dynamic tool, where everyone who is invited to a folder can interact in different ways. It is possible to upload, download, comment and edit documents in the shared folders; all activity is recorded and can even be followed in real time, when for examples writing simultaneously in a document.

1. Weekly assignment:
   The weekly assignment was shortly and relatively loosely introduced

as the last thing before the end of the lessons. This approach was used in order for the students to understand what we would like them to do without putting to many restrictions on how to do it in order to make them solve the assignment in their own (creative) way.

2. Embedding of questions in the papers by teachers:
   For the collaborative annotation the students were asked to download the Notable PDF application available for Google Drive, a tool which makes everyone able to comment, highlight, strikethrough, mark etc. in a pdf document, in this case the papers the students have to read for each week. Notable PDF was used by the teachers to ask questions to specific parts of the text in order to increase the learning outcomes. The students were asked to access the paper and answer at least one question in each paper in each week. Teachers used the collaborative annotation to give hints for answering unanswered questions, guide answers in the right directions, validating correct answers or asking secondary questions to answers.
3. Using the online collaborative platform between classes:
   Apart from answering questions from the teachers, the students were encouraged to use Google Drive/Notable PDF to read the answers to teacher-based questions from other students, to elaborate or correct other students answers and to pose new questions themselves in order to ask for help from other students when a particular paragraph/topic/method etc. was incomprehensible instead of getting stuck alone.

Figure 18.3 shows an example of teacher questions and student answers in one of the papers.

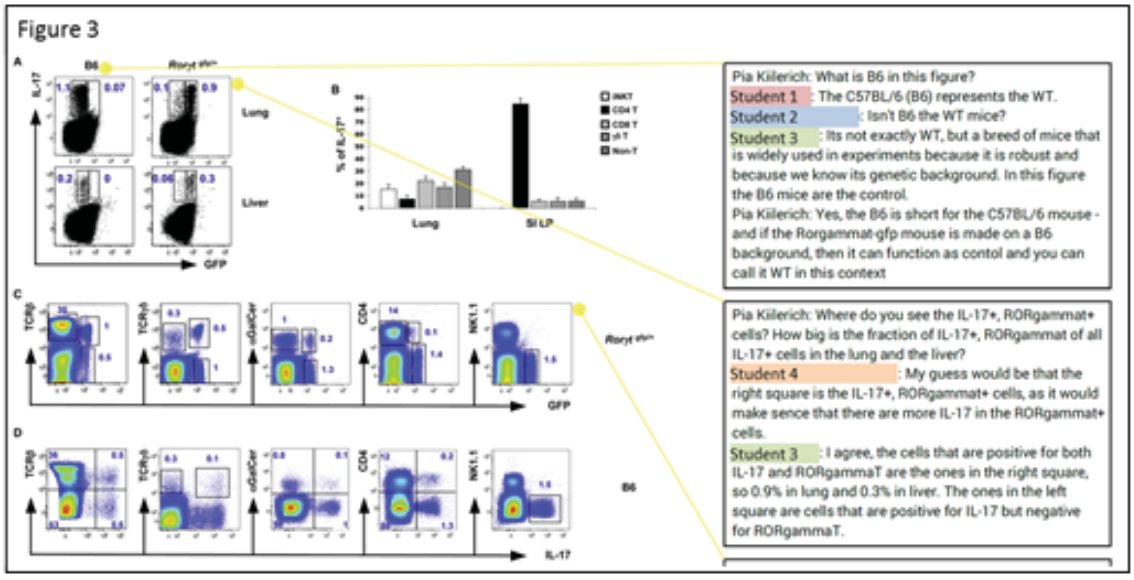

Fig. 18.3. Example of teacher questions and student answers in one of the papers.

Assessment of the teaching intervention

Assessment by the students

A questionnaire was constructed in Google Drive and send to the students in order to assess the success (or lack thereof) of the teaching interventions from the students' perspectives. When writing this assignment, 11 out of 16 students have completed the questionnaire during the Christmas holidays.

1. Weekly assignment:
   Even though the introduction of the weekly assignment was rather vague, all the students were able to understand the purpose of the assignment and chose to complete the assignment in order to increase their learning outcome of the course (Figure 18.4A). The students were also eager to get an evaluation of their assignment and see how other students have solved the same assignment, as the students appreciate the time spend on evaluation of the weekly assignments (Figure 18.4B).

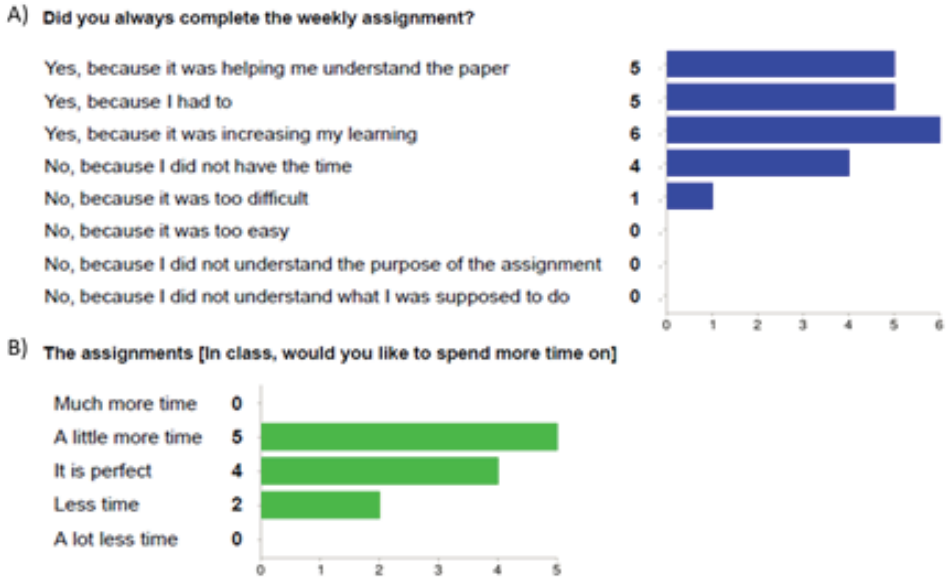

Fig. 18.4. Assessment of the weekly assignments

2. Embedded questions from the teachers:
   Much emphasis was put on this activity by the teachers and the students also find that the embedded questions from the teachers increase their learning outcome (Figure 18.5A) and they appreciate why it is important to answer the questions (Figure 18.5B) and realize the value of this:

   > "I think the questions are an essential part of understanding the paper, and they make me "dig in deeper" when reading and follow up on things which I am not completely sure about."

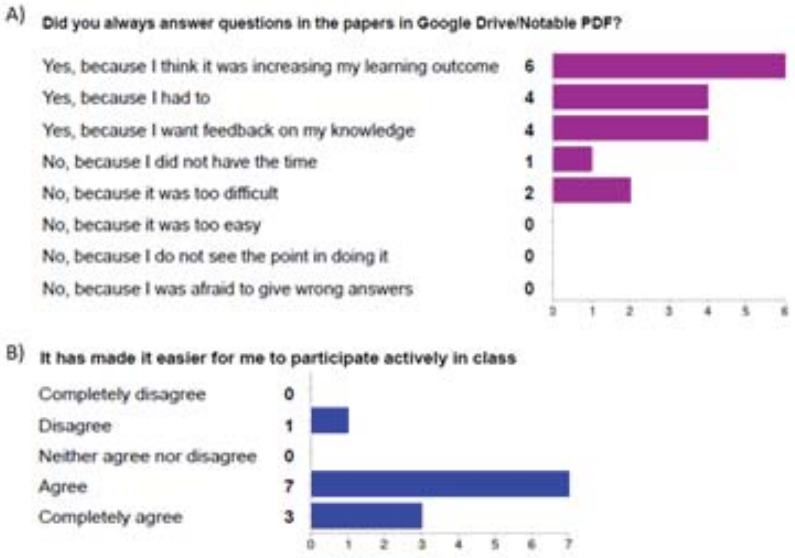

Fig. 18.5. Assessment of embedded questions from the teachers

3. Embedded questions from the teachers:
   Answers and questions from other students (Figure 18.6A, B) were very helpful for the students for increasing their learning outcome (Figure 18.6C).

   Overall the students would recommend the use of this online Google Drive/Notable PDF platform for a course with similar structure (18.7) and they appreciate the support it provides between classes, the possibility to work collaboratively and the increased learning outcome, when using this method. When asked "Would you recommend other courses with the same structure to use Notable PDF and collaborative annotation? Why? Why not?" students answered:

   > "Yes. It is helpful to keep students engaged in the class. People who don't like to speak up in class can sort of speak up in notable PDF by asking or answering questions."
   >
   > "YES! I think it works very well when we are working together to answer a question and can elaborate on answers already made. It is also a good way for the teachers to see what is going on during and maybe prepare something for the next lesson based on problems not answered by the students."
   >
   > "Yes it's very helpful when reading articles, because most

students have the same questions. Normally we more or less left to ourselves as students, so being able to use each other's knowledge helps a lot"

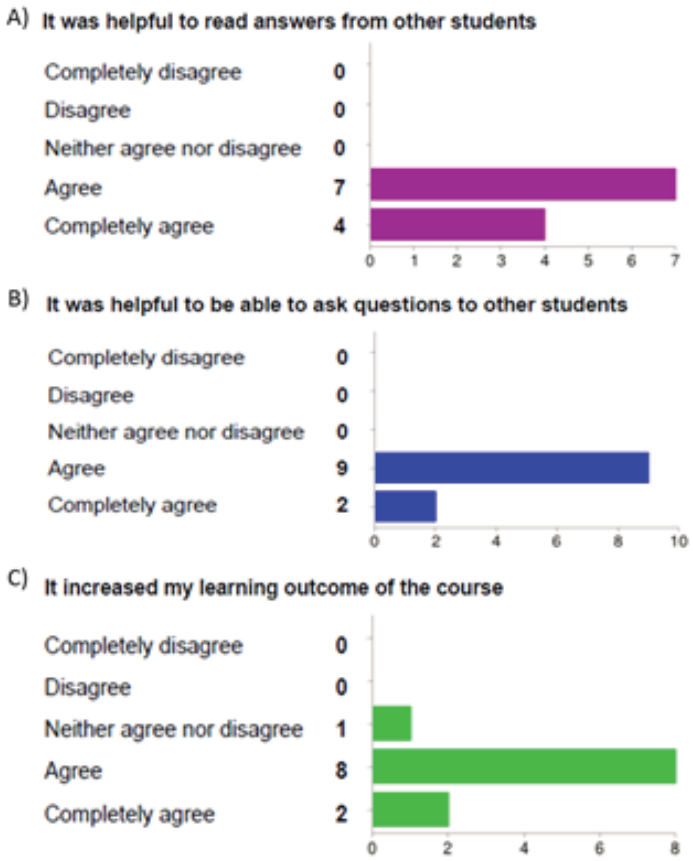

Fig. 18.6. Assessment of the use of collaborative annotation

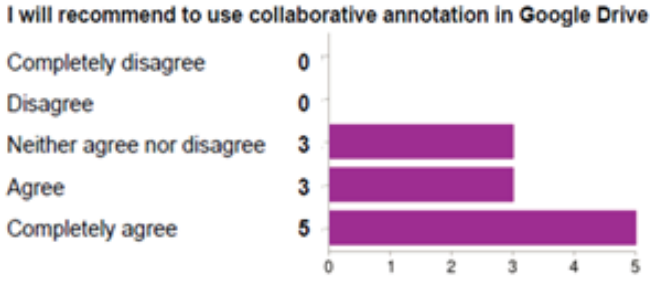

Fig. 18.7. Overall student assessment of collaborative annotation

Own assessment

Compared to last year when the course was running without the collaborative annotation platform the students seem to be more interested in class, they ask more questions and dare to ask about things they don't know. The intervention has given me a better feeling with the level of the students and it is easier to know how to use the limited time during class. Regarding the ILO's there is no formal assessment of the course at this point, and it is thus difficult to assess whether or not the teaching intervention has improved the learning outcomes - this will first be tested after another teaching module with the same set-up followed by a written assignment with an oral defense. However, very subjectively evaluated, the nature of the questions and the perceptiveness of the answers in class from the students seem to be on a higher level of understanding after this intervention.

1. Weekly assignment:
   The learning potential of the weekly assignment was not fully achieved during this intervention due to the lack of time at the end of the lessons where this section originally was placed. Moving the examination of the weekly assignments to the beginning of class has already improved the learning potential. However, the students express that they still learn from doing the weekly assignment even though we do not evaluate all of them in class. Furthermore, it has been hard to find the time for me to go through all the assignments before class and this part of class has thus been a little too spontaneous.
2. Questions from the teachers:
   First of all, making questions for the students has improved my own understanding of the papers and made me better prepared for class. It takes a long time to do this, but from the sometimes really great answers and all the positive statements from the students, I think the time is well spent. Fortunately, there is no doubt in my mind, that the learning potential of this part of the course is high and can still be expanded by using more time on facilitating and guiding the answers and discussions. The goal is to let the students answer, read each other's answers, reflect, and then maybe intervene in the discussion. It is rather difficult to know when to get involved as a teacher and there is probably no fixed model for this, since many scenarios are emerging asynchronously, such as:

"The desirable": The teacher asks a question - student answer – other students read the answer and agree - the teacher validate the answer.

"The learning experience": The teacher asks a question – students answer – other students read the answer, consider, investigate and write a clarification or correction – other students read this and agree – the teacher validate the discussion.

"The unwanted": The teacher asks a question – students answer – other students read the answer and agree - the teacher has to correct the answer.

"The inevitable": The teacher asks a question – no students answer – the teacher help with a hint – students answer – etc.

Of other considerations for increasing the learning potential of the teacher questions, I sometimes emphasize the outstanding answers by letting the particular student elaborate and explain to the other students in class and also I draw attention to the questions that are only partly answered or not answered at all and make the students collaboratively reach an answer in class by asking more or less suggestive questions.

3. Online collaborative platform between classes: The possibility to ask questions from student to student or student to teacher outside the teaching hours seems to be very helpful for the students. They find assurance in this feature and do not feel left all alone. As a teacher it is very helpful for see these questions, which many students might not dare to ask during class, and it is very satisfying to see other students give an answer before I manage to do so. This is freeing up time, from questions only one or two students struggle with, to spend time on problems that are more general for the whole class. The possibility to read each other's answers to teacher or students questions seems to benefit the learning experience for the students, firstly because they do not have to look up everything they do not know for every paper (and that is a lot!), but can rely on other students answers. And secondly, they learn from taking the responsibility of formulating a precise answer that other students will read.

   Again, the learning potential of this part might be expanded by encouraging students to participate more in this activity and by increased teacher activity to facilitate discussions and curiosity.

In conclusion, introduction of methods to constructively align ILOs and TLAs as presented here has improved the learning outcome from both the student's and the teacher's point of view.

Acknowledgements

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All contributions to this volume can be found at:

http://www.ind.ku.dk/publikationer/up_projekter/2015-8/

The bibliography can be found at:

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