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Increasing collaborative learning and knowledge exchange in a case-based learning environment

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Setting the scene…

Bridging the gap between theory and practise, between declarative and functioning knowledge, can be achieved through case-based learning activities CBAs (Biggs & Tang 2011). However to be relevant cases need to address the intended learning outcomes ILOs in a sufficiently complex manner allowing the students to hypothesise, to reflect on their management of the case, in other words to challenge the knowledge their have acquired during or prior the course. Often used in CBAs, group works make use of student-student interaction to increase and/or strengthen student knowledge by encouraging the elaboration or reformulation of known concepts, by developing reflective and critical thinking (i.e. how does one arrive at a given interpretation/conclusion? How what someone else's interpretation of a concept relates to my own interpretation? Is it better or worse than my own interpretation/conclusion?), and by applying theory to practise.

For this project I chose to focus on a 7.5 ECTS master course in Geography and Geology that makes use of group works as way to foster student's functional knowledge. This course is the second part of Remote Sensing of the Bio-Geosphere [1] and runs in block 2 over 7 weeks at a pace of bi-weekly classes (Mondays and Fridays). A contrary to the first part of the course that aims at providing the students with a general theoretical (lectures) and practical (guided exercises) background in remote sensing of the environment, the second part of the course is dedicated to the realisation

[1] course overview at: http://kurser.ku.dk/course/ngek10009u/2013-2014

of a scientific project in remote sensing. Main actors of the course content, the students are asked to work in small groups (2-4 students) on a topic of their choice and to perform a complete scientific analysis from designing the study to synthetizing their results and conclusions in a scientific report. To do so they need to find relevant scientific papers related to their topic of interest and identify the appropriate datasets and relevant methods to analyse them. Several seminars or guest lectures are also part of the course agenda. They are meant to introduce the students with tools/methods that can help them for their project. The final assessment is done at the end of the course in the form of an individual oral examination, where the written project report is used as starting point.

Problem Formulation

Students from the previous years usually showed interest and motivation in this course and in their project. However the previous teacher pointed out that there was a lack of investment in specific types of learning activities, i.e. those that the students did not consider as directly useful for their own project such as reading and discussing papers selected by the other groups. This can be explained by the fact that the students are only assessed based on their final report. As the topics and methods covered by the groups may differ greatly, understanding what the other groups are doing may, in the point of view of some students, seem not relevant for reaching their goals (i.e. solving the issues specific to their project and ultimately passing the exam). However despite the differences in topic, it appears quite often that different groups use similar datasets, methods or face similar technical problems. Therefore they could directly benefit in exchanging information with each other and in sharing their experience of solving issues related to their own project. If all the groups and students engage in a constructive manner, i.e. if they all contribute to the discussion, this type of student-student interaction can lead to an overall increase of knowledge in the class. This is known as “collaborative learning” (Dillenbourg 1999). Collaborative learning allows students to benefit from one another’s resources and skills, and this has been shown to improve the quality of the student experience, the depth of student thinking, and their learning of science itself (Osborne 2010).

In the previous course setting, learning activities meant to increase dialogue between groups and critical thinking already existed but as reported

by the previous teacher, some students did not really engaged in these activities. A typical example of behaviour was the following: each group had to present a scientific paper considered as reference for their topic and all other students were asked to read the paper beforehand. However only a limited number of students did actually read the paper, sometimes resulting in non-productive discussions in class. The previous teacher tried to solve this problem by selecting an opponent group that would lead the discussion in class. But this resulted in the absence of some of the students that were not involved in the process (i.e. not presenting and not part of the opponent group). This example illustrates one potential drawback in courses where group work is the dominant TLA: some students become "impermeable" to what the other groups/students are doing; they show very little interest or are not present in class, clearly signalling that this specific activity is a misuse of their time.

However there are many good reasons why students should engage (even slightly) in works done by their peers. Besides the fact that it gives them the possibility to approach quickly another scientific topic, it also allows them to make important parallels with their own project (in term of topic, data or methods), to critically discuss thematic or methodological issues with students outside their own group, to bring their attention to new solutions not identified within their own group, and ultimately to bring forward their own research. Therefore my research question in this project is:

> "In a course where the major part of the time is allocated to case-based leaning in small groups, how to promote collaboration between group as way to facilitate problem formulation, knowledge exchange, and critical thinking?"
>
> In other words, "how to involve students in collaborative learning in order to increase their own individual learning?"

Re-thinking the course structure

This course is taught in block 2[2] and runs over a total of 14 sessions (classes) that were divided into 5 guest lectures and 9 sessions dedicated to project works. The guest lectures were scheduled on the Monday's and the session dedicated to the projects on the Friday's. My main focus when

[2] At the time of the writing, the course is still running and only two weeks remains before it ends (Cf. TLAs for week 6 and week 7 in Figure 5.1)

re-structuring the course, and especially the sessions dedicated to project work, was to find a way to facilitate the exchange of information/knowledge between groups by involving the students and the class in a different way. Instead of sessions dedicated to 1-2 groups at a time (the other groups remaining most of the time passive), I decided to work in parallel with all the groups, splitting the sessions by themes and not by groups (Figure 5.1). In practise instead of assigning a task such as presenting and discussing the paper of one group specifically, I decided to work with smaller weekly assignments that would allow discussing the cases of all the groups in one session. This way all the groups would have the opportunity to see the other groups progressing in their research and to make a parallel to their own progress.

Main theme	Rationale of the TLA	Weekly assignment
Week 1: Brainstorming on research topics	• Stimulate students' reflection on potential topics of interest • Stimulate the creation of groups that are not solely based on friendship but also on personal research interest	Each student should: • come with at least 2 topics of interest • start thinking of potential groups
Week 2: Presentation of the research questions and related data	• Help the students to formulate their research questions • Provide a quick overview of all the selected topics to the entire class • Stimulate students' exchange on data download • Increase collaborative knowledge	Each group should: • present their research question and related data
Week 3: Discussion groups on methods	• Stimulate reflection and exchange of groups that will use similar methods in their project work • Facilitate dialog between students and encourage collaboration between groups • Increase collaborative knowledge	Each group should: • upload one reference paper on Absalon, as well as 2 questions/issues related to the methods to be discussed in class • read the method section of the reference papers and reflect on the questions posted by the groups that are part of their peer-discussion group
Week 4: Project	• Work on the project	• None
Week 5: Preliminary results	• Work on the project	Each group should: • upload their preliminary results (draft report)
Week 6: Feedbacks from discussion groups	• Provide feedbacks to the students mid-way • Increase collaborative knowledge	Each group should: • read the draft with preliminary results posted by the groups that are part of their peer-discussion group and prepare some constructive feedbacks
Week 7: Project	• Complete week dedicated to the project (3 sessions)	• None

Fig. 5.1. Overview of the main themes (/TLA), their rationale and related assignments for the 9 sessions dedicated to project work.

Besides Tamir (1989) argued that a reason why case-based lessons in science teaching (in his case, laboratory lessons) sometimes failed to lead to deep learning was that the students were not familiar with the process of scientific inquiry. Therefore I organised and planned the themes in a way that resembled to the different stages of scientific inquiry/reasoning: building an hypothesis (identification and formulation of a research question – weeks 1 and 2), designing of an experiment to test their hypothesis (identification of relevant data and methods – week 3), testing their hypothesis (carrying-out the analysis – weeks 4, 5 and 6) and formulating a conclusion based on their experimentation results (synthetizing their findings in a scientific report (weeks 5, 6 and 7).

Creating the environment facilitating the exchange of information, discussion of issues and feedbacks was also one of my main concerns. I decided to use peer-discussion groups, grouping several projects together, as way to facilitate informal but constructive dialogue between groups. In practise two sessions were dedicated to discussion group: one on methods and one on preliminary results. The discussion groups were set based on the similarity of data and methods used in the projects. At the time of writing only one group discussions has been organised, the one on methods (the next one being scheduled next week). The way the 1st discussion group was organised was the following. A week before the class each group had to upload on Absalon one paper they considered as reference in their topic, as well as two questions related to the method section of the paper that they would like to discuss during the group discussion. Each student had to read before the class the method sections of the reference papers and reflect on the questions posted by the other groups that were part of his peer-discussion group. Annexe A shows the guidelines given to the students to structure the discussion and provide feedbacks during that session. I decided not to intervene in the group discussion in order to give the students enough time to create an informal environment facilitating to the formulation and discussion of methodological issues. At the end of the time allocated (30-45min.), we extended the discussion to the entire class (me included), focussing specifically on remaining issues.

Considering different levels of interactions in the class (Figure 5.2) is supposed to create a favourable environment for constructive communication between students. Within the basic working entity (i.e. 2-4 students working on a project), the students can formulate their hypotheses, solve basic or more complex issues and identify other issues that they cannot solve based on the current knowledge of the group, all this in a safe envi-

ronment. Within the discussion group, the students can test their hypothesis and re-formulate/discuss remaining issues with a new independent small audience. Finally dialogue engaging all the students in the class and the teacher are carried out at the end of the 'interaction chain' therefore allowing more advanced discussion as the students have already formulated and re-formulated their issues.

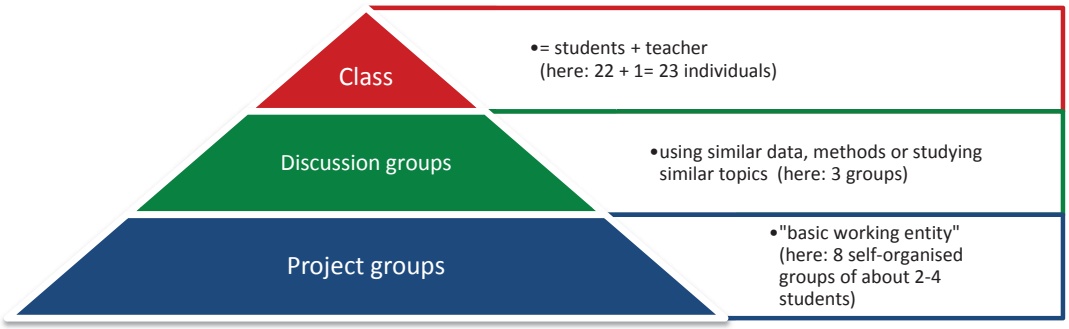


Fig. 5.2. Pyramid illustrating the different levels of students-student interactions and students-students-teacher interactions in the new course setting.

Course evaluation and personal reflections

To evaluate the success of the re-structuration of the course, students were asked to fill an evaluation form on the last day of the course (see Annex B). It was designed to understand whether the new structure of the course helped the students in realizing a scientific project in remote sensing on a topic of their choice. Students' participation to this evaluation was about 30%. Overall the students had a positive impression on the course. A large majority qualified the course as a fruitful learning experience and was satisfied with the work accomplished in the project. Students also agreed that the general structure and the teaching activities of the Friday's classes (dedicated to project work) helped them structuring their work, formulating their research questions and solving technical / methodological problems. Concerning the student-student interactions in class (that notably took place during peer-discussion groups), despite the fact that students are not sure whether they gave good feedbacks to their peers (Q11), they generally

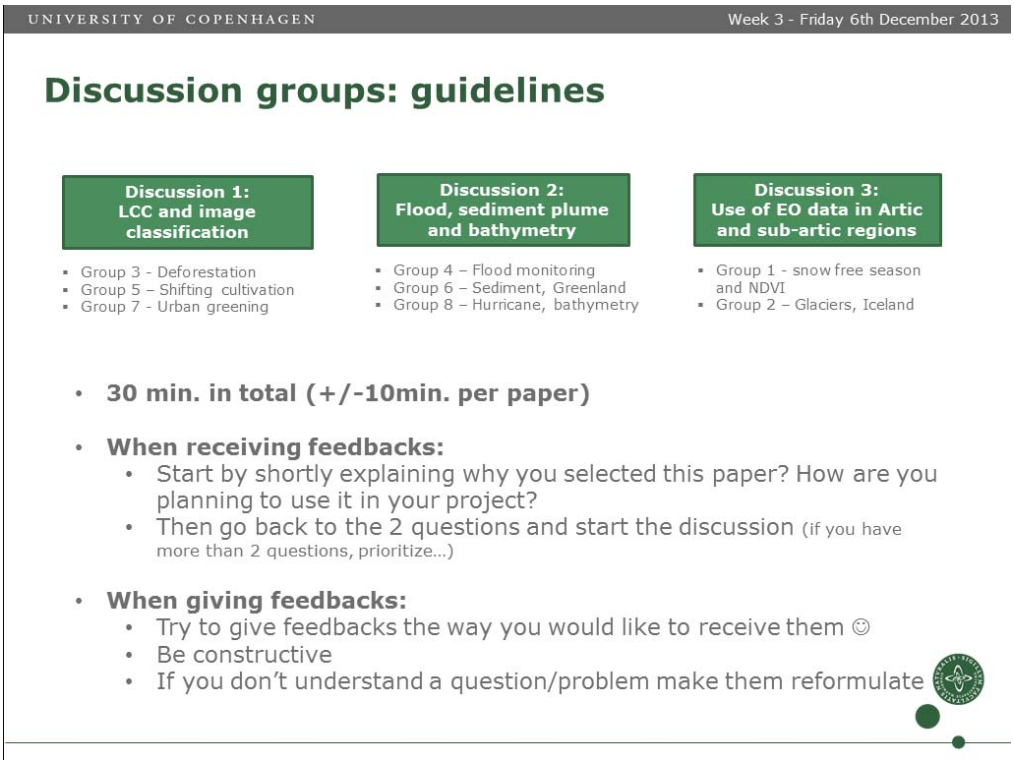
agreed that interacting with other students helped them understanding better the methods they are using for their project (Q7). This exemplifies the fact that either reformulating a specific problem helped the students, or that the other students had the actual knowledge to answer the questions of their peers. In any case, it showed that facilitating student-student interactions, and notably organizing peer discussion groups, is beneficial in the learning process. All in all this evaluation showed that the new design of the part 2 worked well with the students, and it would be interesting to implement it again next year to see if it gives the same positive results with a different group of students.

From a personal point of view, I have been positively surprised by the students' engagement in the different activities. For the brainstorming (which led to the creation of 8 project groups), most of the students had taken the time beforehand to think of research topics that they would be keen in investigating. My only role during that session was to help identifying similarities/parallels between topics. To my opinion, the group discussions on methods worked also quite well: the students were engaged in constructive discussion on scientific methods and managed their time quite well. By regrouping projects based on specific criteria (similar methods), the students understood quickly how/why this activity could be beneficial for their own project. It also increased their awareness of the importance of providing constructive feedbacks to the others, and in that sense involved them in a broader scope that was increasing the collective knowledge of the class. Moreover the fact that week after week the TLAs involved more and more advanced types of verbal exchange in class (brainstorming week 1, presentation week 2, discussion group week 3, etc.) helped the students to feel at ease with discussing with their peers and with me about topics that they did not fully master. The students were also part of the re-structuration process for this course, as they were asked at several occasions to state their preferences concerning the way to proceed with the activities and with the way the student-student interactions were taking place. Notably for the second group discussion, I let them free to decide whether they wanted to continue with the same discussion groups or if they wanted to change. They were also the ones setting the deadline for uploading their preliminary results.

It is important to note that, in order to be successful, this kind of course setting needs to occur in an organised but friendly/informal environment in order not to avoid competition and discouragement/disengagement of the students/groups that may lack behind. The role of the teacher is quite

important as it needs to ensure that all groups/students understood the way the course is organised, what is expected from them and what will be the role of the teacher during the activities (Biggs & Tang 2011). In this course I made sure to explain the rationale of the course setting and the ILOs for each session. I also made it clear since the beginning that the goal of the project was not to discover brand new scientific facts but more to give them a taste of what conducting a scientific project looks like. Therefore I tried to emphasize the fact that there are no negative results. Indeed in learning processes "knowing what is wrong matters as much as knowing what is right (Osborne 2010)". The most important is to discuss honestly the results and to try to identify how these results can bring forward their research field.

A Guidelines for the discussion groups



B Evaluation form to be handed out to the students at the end of the course

Number of students registered to the course	23
Number of students that answered the questionnaire	7
Number of students that indicated not having attended the course	0
Percentage of answers	30%

	I strongly agree	I partly agree	I neither agree nor disagree	I partly disagree	I strongly disagree	I was absent
Related to the general structure of the Friday's classes:						
1. The Friday's classes helped me/us structuring our remote sensing project	4	2	1	0	0	0
2. The Friday's classes helped me/us organise my/our time	2	5	0	0	0	0
3. The Friday's classes helped me/us solving technical or methodological issues	5	1	1	0	0	0
Related to the formation of the groups and the selection of the research questions:						
4. I found the brainstorming session useful to form the groups	2	3	2	0	0	0
5. I worked on a topic that was close to something I suggested or something that I found interesting	6	1	0	0	0	0
Related to the presentation of the research questions:						
6. The short presentation in week 2 was helpful to formulate our research question and to get started with the project	5	0	1	1	0	0
Related to the discussion groups on method:						
7. The group discussion helped me to understand better the methods we applied in our project	1	4	0	2	0	0
8. The other groups provided us with good feedbacks/comments on the methods described in our reference paper	1	3	2	2	0	0
9. Reading the reference papers of other groups helped us to progress in our project	1	1	1	3	1	0
Related to the interaction in class:						
10. The other groups gave good feedbacks/comments on our project during the course	0	2	4	1	0	0
11. I think I gave good feedbacks/comments to the other groups during the course	0	0	5	2	0	0
12. The teacher gave sufficient feedbacks/comments to my group during the course	4	2	1	0	0	0
Related to the remote sensing project:						
13. In our project we used one of the methods / toolboxes presented on the Monday's	6	0	0	0	1	0
14. Overall I am satisfied with the work we accomplished for this project	5	2	0	0	0	0
15. I liked working with my team mates	5	2	0	0	0	0
16. Working on this project was a fruitful learning experience	5	2	0	0	0	0

All contributions to this volume can be found at:

http://www.ind.ku.dk/publikationer/up_projekter/2014-7/

The bibliography can be found at:

http://www.ind.ku.dk/publikationer/up_projekter/

kapitler/2014_vol7_nr1-2_bibliography.pdf/