

Active learning in a multi-instructor Ph.D. course

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Introduction: University courses vary widely in format and structure, depending not only on discipline and the university itself, but also on the education level of the student and resources available and used for organisation, implementation and execution of the course. Here I describe the organisational and pedagogical considerations and content of an intensive multi-instructor course for advanced university students (primarily Ph.D. students and early postdoctoral researchers), which could potentially also be used for students at less advanced levels (Master's, undergraduate). Several aspects of the learning and pedagogical approach are taken from DTU's Universitets Pædagogisk Kursus for Erfarne Undervisere, which I took during fall-winter 2015-2016.

The Ph.D. course was a week-long, residence-based course on "Modelling Biodiversity for Sustainable Use of Baltic Sea Living Resources", held in August 2016. The course was taught jointly by 11 instructors during the week, who each gave a 2-hour lecture and a 2-hour exercise. Instructors were in-residence during the course for periods lasting 1-5 days.

Pedagogical structure and teaching format:

One of the main purposes of the summer school was to educate and train a new generation of young scientists on the challenges and opportunities that face biodiversity in the Baltic Sea and provide them with new knowledge and quantitative tools on how to model its variations and their consequences. The course consisted of a mix of lectures, hands-on statistical analyses/ modelling exercises and discussions.

The course was designed to give the students latest knowledge about sub-topics related to the overall course topic, and also to train them in state-of-the-art quantitative analytical methods, approaches and tools related to biodiversity. When designing the course, careful attention was given to development of Core Elements and Learning Objectives (see end of abstract) and the overall course objectives. The course, as an advanced course, had to be taught as a multi-instructor course. This presented a challenge to ensure all instructors were aware of the overall course goals and that their inputs did not overlap, but instead complemented each others. Overcoming this challenge was done by email, skype and phone discussions in the months leading up to the course.

All instructors, who were leading scientists from foreign universities and institutes around the Baltic Sea region, were told to orient and align their lecture and exercise with the overall topic of the course. Instructors were also told to ensure that programs and scripts actually worked and that all necessary data were available and in readable formats. The pedagogical approach was set up to try to encourage as much active learning as possible via the exercises and also via discussions during the lecture and exercise period.

Students were given two types of exercises to promote their active learning and skill development. One type of exercise were the instructor- and topic-specific exercises designed by each instructor in consultation with myself, and aligned with the overall topic of the course. These were done individually or in groups of 2-3 students, and gave the students some hands-on work with data analyses or models.

In addition to the instructor-specific exercises, the students were asked to do an overall assignment related to a general topic which integrated the specific topics taught by each instructor. The assignment was a written report (max. 1000 words) and an oral ppt presentation of the report on the final afternoon, to be

done in groups of 5-6 students. The topic of this assignment was given by the organiser, along with some suggestions for sub-topics to be addressed in the report, and based on the week's lectures. These assignments gave/forced the students the opportunity to work in groups, allocate tasks, organize their thoughts and reach consensus on report priorities of its text and content. The students were a mix of different backgrounds (nationalities, marine science disciplines, etc.) so they had to overcome that challenge in a short time to make their groups function effectively. They had to work on this mostly in evenings and the last 1-1.5 days of the course, so they had fairly limited time. During the week they got feedback during breaks and in evening discussion sessions.

The course was designed to allow student peer-review and feedback to other students. While the lead organisers were evaluating the 4 written group reports on the final afternoon, we gave the students another task (i. e., student peer-review of other students' work). They were told to read all the 3 other Group reports, and do a peer-review of one of those reports, assigned by the organiser. They then presented their peer-review as a ppt presentation to the entire class later on the final afternoon. This peer-review was not intended for assessment purposes but instead only for the students to learn how to do a review, to see other perspectives on the same problem and for students to get some feedback on their reports.

Student enrollment: The maximum participation was set at 25; due to last-minute cancellations, we had 23 participants. The student mix was from a broad range of Baltic countries, although there were a few participants from non-Baltic (southern European) countries; Danes or students registered at DTU represented a very low proportion of the students. The gender ratio was 16 women and 7 men. Most students did not know each other before the course.

The course was conducted in Sømimestation, Holbæk; the facility is owned by Roskilde University and is a residence-type facility so students and most instructors lived together during the week. This helped promote discussions and networking. The application procedure to attend the course included a student CV and a 1-page maximum expression of interest and justification for taking the course. Notably, a large number of students identified networking with other students and foreign researchers as one of their most important motivations for taking the course.

Assessment of student performance: The course grade was pass/fail, as is typical for DTU Ph. D. courses. Since we wanted to complete all grading and assessment within the course week, I and another instructor read and evaluated the 4 group reports on the final afternoon. We then reported back to the students later in the afternoon.

The course was accredited for 2 ECTS credits by the DTU Ph. D. School.

Student experience and evaluation of the course: We asked the students to perform the standard DTU course evaluation form during the final afternoon of the course. We received very good feedback on the course based on the course evaluation. Summary results will be presented during the presentation.

What went well and what could go better: Overall the course was a success based on the student feedback and also on the input from the other course instructors. Nearly all found the topics interesting and that they learned very much. Students learned new modelling approaches and softwares which they could take home and apply to their own research projects.

Part of the success is due to the effort put in to plan the overall topic, the subtopics and coordination of instructors with the course objectives. This is considered absolutely essential to the course content and the

student learning experience. i. e., it gives students a feeling that the course topic and format has been well-prepared and organised.

Some of the exercises were more effective for student learning than others. Some instructors actively engaged the students with analyses, while 1-2 others basically rolled through pages of R programming script explaining what the lines did. In these cases, students were more passive learners. However even in this case, they now have working scripts and programs that they can use later in their research projects and the contacts to the scientists who wrote the codes if they want to ask for advice and assistance.

The students worked hard during the week and also did some reading preparation beforehand. They should have received more than 2 credits so next time we will request for higher credit. They interacted well and took their tasks seriously. The students performed well, especially given the time constraints and the challenge to form cohesive work groups with people having different backgrounds and that they had not met before.

Application to other university levels of teaching: The approach of this course would probably work with Master's and even advanced undergraduate students. However, the ambition and expectation level would have to be lowered somewhat, simply because these latter students don't yet have the research experience of having already completed their own research project, and doing a lot of their own research writing as Ph.d. students usually do. The course could probably also work in a less time-intensive format, i. e., spread over 2-3 weeks.