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Helping less to strengthen active student-centred learning in exercise classes

Mette Frahm Olsen

Department of Nutrition, Exercise and Sports
University of Copenhagen

Introduction

There is increasing focus on student centred and student activating learning in university teaching as an approach to enhance deeper and more meaningful learning among students (Prince, 2004). Many courses include a mix of lectures and exercise classes, where students get a chance to solve problems during exercises related to theoretical concepts presented in lectures. Although these exercise classes are student activating in nature, large diversity of the students often make it extremely challenging to find a level of questions that does not leave behind the weaker students, while still being relevant for the stronger students in the class.

I have been involved as a teacher in exercises about nutritional epidemiology as a PhD student, about 10 years ago, and again recently as a Post Doc. Several minor changes to the approach have been made in the meantime, but the exercise classes are still not working well and suffer from problems arising from a huge variation in student background, experience and skills.

The exercises are part of an MSc course and build on basic statistical and data handling skills that the students are expected to have attained during their BSc programme. However, many students struggle with these basic skills and have difficulties doing the calculations required to be able to interpret and discuss the epidemiological concepts. Over time, the approach from myself and other teachers involved has been to increase teacher-directed input in terms of including more detailed step-by-step guides in exercise instructions as well as having three teachers present to help solve

students' questions during class. However, classes have continued to be dominated by frustrated students who get stuck in analyses and need help from a teacher to move forward. The last 35-40 minutes of classes are spend in plenary discussion of the exercises and the challenge of covering all needs in this discussion further highlights the issue of student diversity.

With the additional help offered, these exercises have become increasingly teacher-directed, instead of student-centred, with many of the students requiring 1:1 input to be able to solve questions. With 60-70 students in class, this is clearly not feasible and rather than being activated, many students spend the majority of time waiving their hand in the air and waiting passively for help from a teacher.

During the University Pedagogy course, I was part of a pre-project, which looked at drivers of students' transformation from a passive mode of learning to a more proactive and self-driven mode of independent learning. After interviewing PhD students and supervisors, our main conclusion was that the independent learning mode can be promoted when students feel ownership and take initiative, and that supervisors may facilitate this by being less controlling, giving less detailed instructions and not spoon-feeding answers, but instead providing resources and autonomy for students to find the solution themselves. In other words, the opposite of what we have been doing in my exercise classes…

Consequently, the teachers involved decided to implement some more radical changes to the exercise classes this year: We removed presence of all teachers during the main part of exercise classes and all teacher-directed help in the written instructions. Instead, we provided alternative online resources for students to see if this would push them toward more self-driven active learning.

Context: course, students and previous attempts to improve learning in exercises

The exercises are part of the course "Evidence, Diet & Health" which is a compulsory 7.5 ECTS course placed in block 2 on first year of the two MSc programmes: "Human Nutrition" and "Clinical Nutrition". About a third of the students have a BSc in "Food Science" or "Exercise and Sport Science" from University of Copenhagen, another third have a Bachelor (i.a. Professionsbachelor) in "Nutrition and Health" from University College Copenhagen and the last third are international students with various

backgrounds. The course includes lectures, journal clubs and a total of four exercise classes, of which I am responsible for three.

Each of the exercise classes has a duration of three hours and students work in groups of four. Groups are made by the course responsible, who aim to combine students with different types of background to get the weaker and stronger students working together. They are given a dataset and questions relating to a topic that has been presented in a lecture earlier in the course, e.g. "sample size and power". Students can use whichever statistical software they prefer for analysing data.

The intended learning outcomes (ILOs) of the course include overall competences of assessing the validity of nutritional studies and evaluating evidence of relationships between dietary components and health. To achieve this, it is essential that students develop a good understanding of the epidemiological concepts that are discussed in exercise classes. The competences are assessed in the final exam, where students are asked to critically assess nutritional studies reported in scientific papers. Course ILOs also include more concrete knowledge and skills outcomes on data management and analysis, such as "describe the structure of a data set and types of variables" and "demonstrate ability to handle a data set with nutritional variables and to assess for confounding and effect modification". These ILOs are closely related to the content of my exercises and they are assessed separately in a statistical assignment during the course, which must be passed before the exam can be taken.

One of the admission criteria of both MSc programmes is 7.5 ECTS credits of statistics, but in practice, many students are not confident with basic statistics and they have no common software experience. This challenge, along with the general diversity of student backgrounds and academic skills, result in limited learning outcomes for the students. Much of the time is spent on struggling with statistical software, rather than discussing the relevant epidemiology, which students generally find difficult. After the course, only few students ever use the same statistical software again, so little is gained from these efforts.

The exercise classes require a lot more teacher resources than what is allocated in terms of UAT. The assisting teachers are often PhD students, who change from year to year, and each year we therefore need to find new teachers and introduce them to the exercises. However, I think the main issue with these challenging exercise classes is that many students get immensely frustrated and stressed and the resulting atmosphere isn't very conducive for anyone's learning.

Previous attempts to solve the problem have included a one week introduction to basic statistics and data analysis using R (stat. software). The idea was for weaker students to catch up, but we found that it was not enough for these students, while others were bored and complained that time was spent on topics that had been covered on their BSc programmes. Also, it left too little time for the actual course. The most recent attempt has included providing hints for R coding in the exercise instructions. However, this hasn't worked well either, as only students with good data handling skills are able to read and use these hints and teachers end up handing out entire R scripts for the majority of students, when they get stuck.

New approach: Reducing teacher-directed input and providing alternative resources

In collaboration with the course responsible and two other teachers involved in the course, we decided to try out a new approach this year, where no teacher will be present during the first two hours of exercise classes. I rearranged my exercise instructions to clearly divide questions into "calculation" and "interpretation" sections. At the same time, I removed all hints and help for solving the calculation questions, including equations, coding of analyses, sample size tables and other concrete input that was previously provided in the instructions. I gave an introduction to the exercises (in the written instructions and orally when meeting the students), in which I explained that the aim of the classes was not to teach statistics or use of software and that we would spend time in plenary discussing the purpose of the analyses and the implications of their results, rather than how the results were achieved.

An online toolbox for statistics was developed and set up as a separate site on Absalon called "Introduction to statistics", which included help for choosing and installing statistical software, getting an overview of data, basic data handling functions such as generating new variables and stratifying data, choosing a relevant test and conducting selected analyses. Some of the help modules are general (e.g. about choosing between tests) while others provide specific help for one of two selected statistical software (R and SPSS). The toolbox also includes links to additional online resources (e.g. an online sample size calculator and Youtube videos with instructions of how to load and open data in R).

The students were encouraged to look at the exercises before class and, if finding them difficult, to familiarize themselves with the content of the toolbox, find their notes from previous courses, discuss with their group, read a book, ask a classmate, or consult google for a way forward.

I prepared two detailed answer files for the exercises, which included coding and output of analyses in R and SPSS, respectively. These were made available on Absalon immediately after the exercise classes.

The aim of this new approach to the exercise classes was to redirect student attention to the concepts of epidemiology rather than the tools and analyses involved. With less direct teacher input and more general resources provided for software and analyses issues, we hoped to enable students to find solutions on their own, rather than waiting passively for a teachers directions.

Plan for evaluating the new approach

This was the fifth time I taught the exercises and I was therefore familiar with how students usually respond during class. Part of the evaluation of the new approach was therefore just based on my own subjective comparison with previous years of how many questions students manage to complete, where they get stuck, what type of questions they have, as well as an assessment of the general frustration level in class.

I joined the classes after two hours and spend about 20-25 minutes walking between groups before the discussion in plenary. When talking to individual groups, I asked students how far they had come, what they found was easy or difficult, how they had made the calculations and analyses, and what resources they had used to solve them.

I ended the plenary discussion with a short oral evaluation, asking students if they found the exercises were useful, if they had found sufficient resources for working on the questions, and if time was well spend on group work and plenary discussion.

The course is still ongoing at the time of writing this assignment. After its completion, it may also be relevant to compare students' evaluations and exam results, including outcomes of the statistical assignment, to previous years. Several other factors may play into this, of course, but it might still be useful for assessing if students' learning outcomes have improved after changing the approach to exercise classes.

Findings

While moving between the groups two hours into the exercise classes, it was clear that many students found the exercises difficult and the majority had only been able to complete a few of the questions. This was not very different from previous years, but there was a striking difference in the general atmosphere among students. Whereas these classes are usually charged with frustration and accusations of teachers being too few and too slow to respond to requests for help, students were now using their energy on trying to find solutions(!) Not all students had used the toolbox we made, but nearly everyone was doing something to find a solution. Approaches mainly included googling and using notes and other material from their BSc course on statistics. The students with stronger data analysis skills were very active in explaining and helping group mates as well as other groups.

In the oral evaluations, many said that they found exercises were difficult but that they were able to find useful resources. Some students said that both group work and plenary discussions were useful for learning, while others asked for less time working in groups and more time discussing in plenum, since they had not been able to solve the majority of questions on their own. Some also asked for a teacher to be present during group work, so they could solve their questions faster. However, after discussing the aim of the classes, there was better support for the approach.

Discussion and conclusion

I found the reduction of teacher-directed help in exercise classes was extremely conducive for improving independent and active student-centred learning. I must admit that the idea came from others and that I was hesitant to try it at first. Teaching a class of frustrated students can be quite intimidating and my own intuitive approach, up until now, has been to meet students with more and more detailed guidance, when they were not able to solve the problems we presented them with. I think it is interesting and actually a bit of a paradox that students previously were given much more direct help, and still complained that they did not receive enough, while this year's students seemed much more at ease with only being presented to strategies with finding help elsewhere.

This new approach did not seem to help students much in terms of solving more questions during exercise classes, but the fact that they managed to find some of the solutions on their own, has probably resulted in a

more meaningful understanding of the concepts, rather than rote learning of codes provided (Entwisle, 2009). In addition, students are now more aware of where to find resources that will be useful for other situations, whereas the direct help for specific analysis in previous versions was difficult to make use of later on.

I am not sure how many students will work on the remaining questions after class, but I think it would be very useful for them to spend more time on the exercises and to compare their approach and results with the answer file that I prepared. In next year's course, I will emphasize this and encourage students to get back to me in the following class, if they have questions or difficulties with the previous exercises.

The use of teacher resources for the course now better match the UATs allocated. On a more general note, I think it is notable, that although it is well-known and widely acknowledged that better learning is achieved when students are active, they often request more teacher-driven input and this is often also the intuitive response from teachers. In the case described here, it required an active push out of the comfort zone for both students and teachers to improve student-centred learning.

It is also generally acknowledged, that the existing level of knowledge among students is one of the most important factors influencing learning and that teaching should be adjusted according to an assessment of the students (Ausubel et al., 1978). This highlights the challenge of teaching in a class of highly diverse students. The student-driven approach provides some flexibility and allows for differentiated teaching, whereas a very teacher-directed approach must aim to fit all.

In this course, the challenge of activating students was exacerbated by the large diversity among them, but the strategy of helping less to promote student-centred learning will be equally relevant in a less diverse group of students.

Our University Pedagogy pre-project on how to facilitate a more independent mode of learning also included a conclusion about giving students enough time to get stuck and figure out on their own how to move on. This is probably one of the central experiences for becoming self-driven, but often not feasible or realistic to do as part of courses. However, after this experiment with exercise classes with limited teacher-directions, I think they can serve as an opportunity for students to be exposed to a more proactive approach to finding solutions.

References

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