

## Stimulating student activity outside the lecture

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### Introduction

Student activity forms the basis for student learning, and a wide range of methods have been developed and evaluated for stimulating student activity during lectures and exercise classes (Biggs & Tang 2007, Mazur 1997, Oikkonen 2009, Splittorf 2009) as well as activation tools for e-learning and interactive social media tools such as forums or chat rooms (Biggs & Tang 2007, Ch. 7). However, it is just as important to stimulate student activity outside the classroom, as this is where most of the students' time is spent. This is perhaps especially important in mathematics oriented courses, where it is necessary for most students to work actively and independently with the course content in order to learn it.

The aim of this project was to develop and test strategies for increasing student activity outside the lecture hall in the course "Data Analysis" taught in spring 2012 at the Department of Computer Science at the University of Copenhagen. Since lecture and exercise time is rather limited in a typical computer science course, most of a successful learning process must necessarily take place elsewhere. An important component in optimizing student learning is thus to stimulate students to work and prepare themselves outside the lecture.

Two different strategies were planned and implemented:

- A) Case-based teaching, intended to encourage the students to prepare for lectures, and

- B) Carefully planned case-based weekly assignments (constituting the exam) optimized to create a need to engage in course content and material.

The effect of the strategies was measured using two questionnaires at the beginning and middle of the course, a focus group interview at the end of the course and the general course evaluations, also at the end of the course.

Strategy A did not have the desired effect on stimulation of student activity and preparation for lectures, but the students reported that they liked this form of teaching very much; it made the course more interesting and meaningful, and made the theory more accessible.

Strategy B, however, proved to be very effective in stimulating student activity and the exercises were well received among those students who completed the course. A number of students dropped out of the course at the second home assignment, most likely because of the work load. A future challenge is thus to keep the success of the exercises in stimulating students to work while making the exercises accessible to a larger group of students.

## **Description of the course**

Data Analysis is a course primarily intended for third-year Computer Science students. For many of the students, this is the last course in their bachelor degree. The intention of the course is to teach basic data analysis techniques and spur interest in data analysis by engaging the students in exciting problems and applications. The learning objectives included understanding and implementation of specific data analysis methods; choice of method; and analysis of methods used and results obtained. The exam consisted of graded weekly assignments, which were case-based exercises that typically involved analysis of a real problem, choice of method, implementation of the method and analysis of the results, taking into account the strengths and weaknesses of the method. Student collaboration was encouraged, but reporting was individual.

In addition to the official learning objectives, I had a personal agenda, which was also aligned with an unofficial purpose of the course: The students should have fun while learning. The weekly exercises were designed to give room both for a simple, standard solution but also for a deeper analysis and solution of the problem, intended to engage interested students.

## Implementation

The two strategies were implemented as follows:

- A) Each lecture ended with the presentation of a practical case, related to the theme of the following lecture, accompanied by reading material. The following lecture started with the same case, followed by an invitation to discuss the case. Throughout the lecture, the case returned as an example and at the end a final answer would be discussed, based on the lecture.
- B) The weekly assignments all consisted of a practical case problem, sometimes accompanied by purely theoretical questions. Part of the problem was always an analysis of the choice of method and a discussion of possible improvements to the method. The effect of the assignments was continuously monitored through dialogue with the students, teaching assistants and the course responsible, as well as through questionnaires.

The effect of the two strategies was measured through the following means:

- Two five-minute questionnaires were completed; one during the first lecture and one after the second weekly assignment was completed. Their purposes were (1) to gain an impression of how the students normally work, and what motivates them to work, and (2) to gauge the effect of the case-based teaching and the weekly assignment on the student motivation, preparation and enjoyment. All students present participated.
- A focus group interview was held at the end of the course with four volunteers from the course. The interview revolved around motivation to work, and lasted 39 minutes. As the interviewees were volunteers, we assume that these were engaged students who enjoyed the course, and that they are not representative of the student population as a whole. They do, however, tell us something about what makes strong students enjoy and work hard on a course.
- The course evaluation consisted of an optional online questionnaire. Again, we cannot assume that the evaluation is representative of all students.

## Results

The evaluation shows two main findings. The case-based teaching captures the students' interest and helps them engage in and understand the theoretical material, but it does not make them prepare more for lectures, see figure 8.1. The interview suggests this might be because the students are invariably pressed for time with compulsory graded assignments, which they prioritize higher than preparing for lectures, or even doing assignments that only require passing.

“I had Datanet at the same time, where you had to get two assignments accepted, and we just made them two days in advance because we knew we could resubmit them after being told what was missing. Here [in Data Analysis] we knew from the start that they [the exercises] were the basis for our grade, so you know you have to work just as hard on all of them in order to pass the course, and then this became the interesting [course].”

Another reason is that lectures seldom require preparation (perhaps because students are known not to prepare, see figure 8.2), and the students report that preparation is not worthwhile:

“Whenever I read the course literature, the lectures tend to become trivial.”

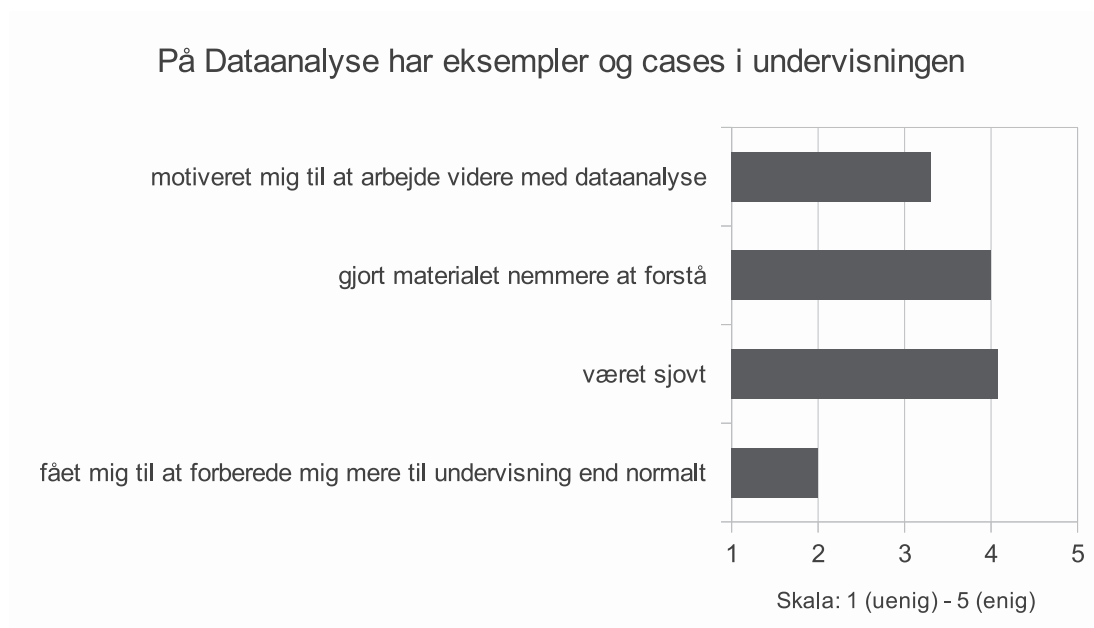
The second main finding is that well planned weekly assignments actually work well in forcing students to work and engage in teaching material, see figures 8.3 and 8.4(c), and in the final evaluation they were reported as either “good, but challenging” or “wildly exciting and fun” by 73 % of the students (Fig. 8.4(a)). The work load was evaluated as suitable by the students who completed the course (Fig. 8.4(b)). The participants in the focus group interview, who are assumed to be among the more resourceful students, describe their most enjoyable classes as difficult, hard work, with a good balance between theoretical understanding and applications.

“... it is the coupling of theory and practice. We made this exercise with hands [in Data Analysis], where we found the average hand. We made 5 pages of mathematical computations and then an implementation that was 5-10 lines, that could compute this thing that we had sat and done by hand for a really long time. That you can combine such complicated theory and in the end get something very beautiful, that is quite fascinating, I think.”

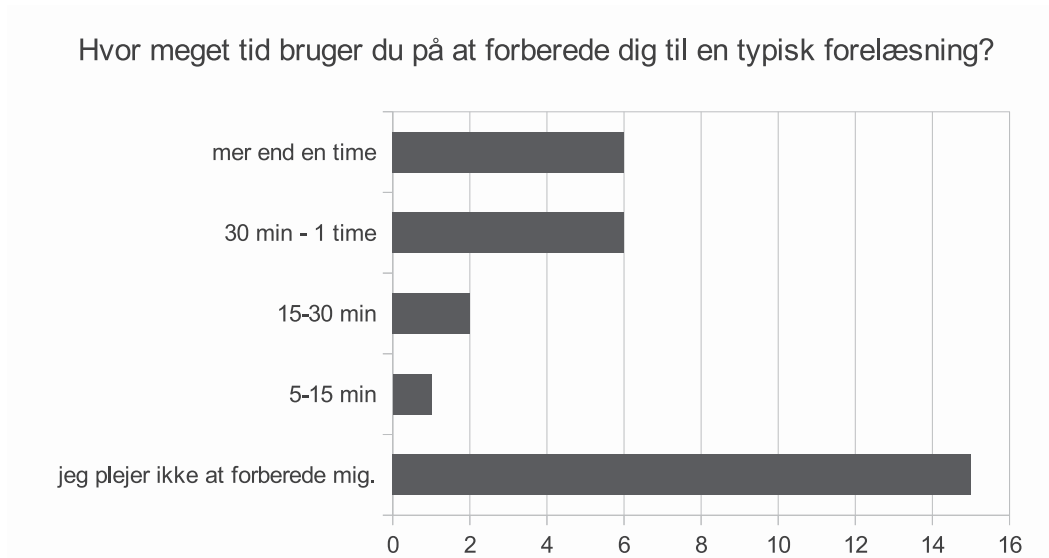
“The course in operating systems was incredibly exciting, incredibly difficult, but incredibly exciting. I like making things that people can use, and everybody needs an operating system.”

“I sometimes think it can be fun just because it is something to learn. Math is like that for me; I usually start out slow, where I read a bit and get started. Then after about four weeks I start to understand things, and it starts to be interesting, not so much because I discover that I can use it for something, but because it is a lot of fun to learn and see that you can actually solve this equation or make this proof. I don’t have the idea that I will use it for something when I’m in the situation. For instance, when you learn about integrals... but then later, you discover that you actually use them for a lot!”

Based on the interviews, questionnaires and evaluations, the use of exercises to make the students work thus seems like a promising strategy.



**Fig. 8.1.** In the Data Analysis course, case-based teaching made the subject more fun and more easy to understand. These effects were stronger than the effect on motivation to work with data analysis. (Translation: In the course Data analysis, cases and examples in the teaching have motivated me to work more with data analysis, made the material easier to understand, were fun, made me prepare more for class than I normally do. Scale: 1 (disagree) – 5 (agree).)

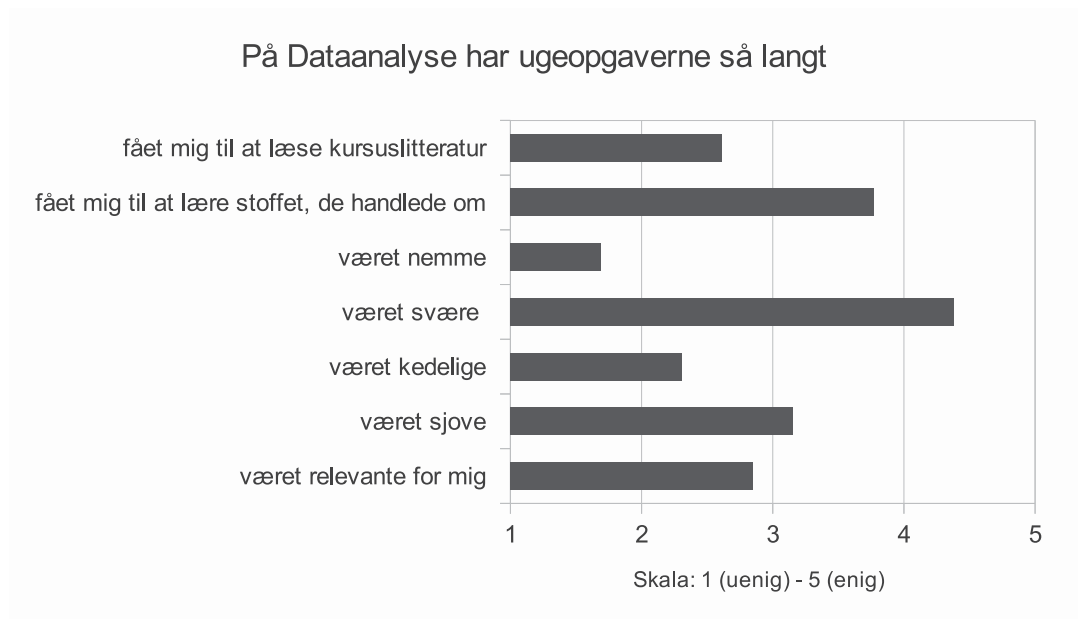


**Fig. 8.2.** From the start, the class was bimodal when it came to preparation for lectures. About half the class would prepare relatively well, whereas the rest would not prepare at all. (Translation: How much time do you spend preparing for a typical lecture? More than 1 hour, 30 min – 1 hour, 15 – 30 min, 5 – 15 min, I do not prepare.)

## Discussion

The effect of cases on student preparation might be improved by strengthening the link between cases, lectures and weekly assignments. The weekly assignments were scheduled for the week after the corresponding lectures, for the material to settle. As a result, the students were constantly one week behind. This also affected the weekly ungraded exercises with a teaching assistant, that were intended to prepare for the following week's assignment. As the course progressed, these exercises were entirely neglected. The problem was that the deadline for the current assignment was the same evening as the exercise, and these classes were almost exclusively used for working with the current assignment. Due to the tight link between the graded assignments and the students' decision to work with course material, there should be minimal time between the introduction of material in the lecture and the students' need to use the material in a graded exercise.

On the other hand, the well-designed graded assignments had a good affect on spurring the students to engage in the course topic; however, a number of students dropped out of the course, and we link this directly



**Fig. 8.3.** The weekly assignments proved very useful in motivating students to work; they were, however, also perceived as difficult. This questionnaire was answered immediately after the second, most difficult, assignment. (Translation: In Data analysis the exercises have so far made me read course literature, made me learn the relevant material, been easy, been hard, been boring, been fun, been relevant for me. Scale: 1 (disagree) – 5 (agree).)

with the high work load in weekly assignment #2. These findings suggest that we should not be afraid to make the students work for good grades; we should rather be afraid of making decent grades unrealistic.

The requirements for passing a course, getting a good grade, and – perhaps – getting special recognition in addition to a good grade, should be made completely clear from the start. It should be possible for a strong student to get a top grade within the intended work load of a course, but there should also be extra challenges for those who want them, and there should be some sort of acknowledgement for those who make an extra effort.

“In our very first programming course, there were these extra exercises where the teacher had said I’ll give a beer or soda to the best solution. That would work really well, to have assignments that you can do within reasonable time, and then extra exercises, where you could say I have time this week and this topic is super interesting, so I’ll do the extra assignment and see whether I can get the best solution. I think that seems really, really good.”

Jeg synes at ugeopgaverne var:

Irrelevante og dårlige	0%
Kedelige	18,2%
OK	9,1%
Gode, men krævende	54,5%
Vildt spændende og sjove	18,2%

(a) Translation: The weekly assignments were irrelevant and poor, boring, OK, good but challenging, wildly exciting and fun.

Jeg oplever arbejdsbyrden på kurset som:

Alt for lille	0%
Lidt for lille	0%
Passende	36,4%
Lidt for stor	45,5%
Alt for stor	9,1%
Ved ikke	9,1%

(b) Translation: The work load was much too low, a little too low, suitable, a little too high, way too high or don't know.

Ugeopgaverne har tvunget mig til at sætte mig grundigt ind i undervisningsmaterialet og forelæsningslides:

Helt enig	54,5%
Enig	36,4%
Hverken enig eller uenig	9,1%
Uenig	0%
Helt uenig	0%

(c) Translation: The weekly assignments forced me to thoroughly engage in course material and slides. Completely agree, agree, do not agree or disagree, disagree, completely disagree.

**Fig. 8.4.** From the course evaluation, which was answered by eleven students.

One potential pitfall with optional additional exercises is, however, that optional work will easily be sacrificed in competition with more pressing compulsory exercises. One potential solution might be to offer some sort of official recognition for those students who do make an extra effort to do optional work, for instance an extra distinctive diploma or honors version of the course which gives an extra motivation for prioritizing challenging additional tasks.



## Conclusion

In this project, two strategies for increasing student activity outside the lecture have been planned, implemented and evaluated. The first strategy, case-based teaching, did not affect student activity, although students reported that this type of teaching made the course, and in particular the theory, more enjoyable and easier to understand. The second strategy, strategic design of weekly assignments, was, however, very efficient. Future work includes fine-tuning the use of assignment design to keep the positive effect on strong students while making the assignments more accessible to students with a weaker background, lower motivation or less time to spend. This includes, in particular, an investigation of the effect of extra assignments for engaged students in competition with other demanding courses.

All contributions to this volume can be found at:

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