

Replacing lectures with videos and other e-learning material - experiences, evaluations and effects.

Goltermann, Per

Professor

Technical University of Denmark

Lyngby, Denmark

Email:pg@byg.dtu.dk

Conference Key Areas: Clustering different types of engineering schools; Continuing engineering education; New learning concepts for engineering education;

Keywords: E-learning, clustering, continuing education, self-study

1. INTRODUCTION

The topic “Basic concrete structures” is being taught at the Technical University of Denmark (DTU) to several engineering educations, as BSc Civil Engineering, BEng Building Engineering and BEng Architectural Engineering. This is a challenge and requires substantial amounts of resources at the university, but also large amounts of the student resources in order to learn the topic.

The courses at DTU are 5 ECTS point courses, corresponding to an expected total of 140 hours of work for each student. This is distributed as 4 hours per week in 13 weeks, dedicated to lectures and exercises and a 4 hours exam, while the remaining 84 hours are allocated to self-study. It is always a challenge for students to learn as much as possible in their self-study and to achieve this in an efficient and meaningful manner.

The teaching of the students is also a substantial and important part of any professor’s work, where the professors usually wish for the students to learn as much as possible.

It has therefore been decided to start a development project in order to improve and modernize the teaching and learning in this area and in others. A significant part of this is to create learning resources suitable for self-study, which may supplement or even replace the lectures.

2. THE SITUATION AND WHY WE WISHED TO CHANGE THAT

Teaching in the concrete structures courses used to be based on a traditional, linear and deductive teaching approach using a textbook, lectures, exercises and solutions, mandatory assignments and a written exam.

This has already been changed towards an inductive approach, which both increases the student motivation [1], [2] and facilitates their understanding and ability to learn and understand (according to the annual course evaluations).

The mandatory assignments were abolished in 2009 in favour for the written exam, partly due to an ambition of an efficient use of the available resources and partly in order to provide a possibility for the student to have a more independently planning of the study activities. This did not lead to any change in the percentage of students passing the courses (Table 1), but did actually improve their performance at the exam.

Table 1. Statistics over number of students signed up for courses, attending exercises and passing courses in spring semester. Note 1: Courses are biannual until 2010. Note 2: Grade and passing based on a combination of the written exam and assignments (abandoned in 2009). Note 3: Exam due later.

Semester Spring	Signed up for courses	Attending exercises (average)	Signed up for exam	Passed Course
S2008	177 ¹	Not counted	167	114 (68%) ²
S2009	193 ¹	Not counted	178	120 (67%)
S2010	222	142	213	173 (81%)
S2011	231	136	220	151 (69%)
S2012	230	151	227	159 (70%)
S2013	236	131	(-) ³	(-) ³

Table 2. Statistics over number of students signed up for re-exam in semester after failing, attending exercises and passing courses. Note 1: Courses are biannual until 2010 after which a “concrete café” is initiated and the numbers in 2008 and 2009 represent those students, who sign up for a re-exam the following semester.

Semester Autumn	Signed up for concrete cafe	Attending exercises (average)	Passed Course
A2008	(20) ¹	(-) ¹	11 (55%)
A2009	(25) ¹	(-) ¹	13 (52%)
A2010	12	8	5 (42%)
A2011	24	10	12 (50%)
A2012	25	4	17 (68%)

Another change in the courses in 2010 was to teach the course once a year instead of twice a year. The students, who wished to make another attempt at the re-exam in the following semester, could instead attend a “concrete café”, where they could work together and also have the benefit of a teaching assistant two hours weekly, plus a final question session with the teacher prior to the exam. The “concrete café” focus

on this special group of students, who have already some understanding of the topic. The concept seems out to lead to the same student performance at the exam as in the past, where they could follow the lectures (Table 2).

It was decided to identify, which resources the students actually used and what benefits they gained from these. A questionnaire by DTU's LearningLab [3] revealed (99 answers) that only a few of the students read the textbook before the lectures and some even only used the book to the extend required to solve the problems at the exercises. It revealed that most students focused at the examples and the exercises (Fig. 1 and Fig. 2).

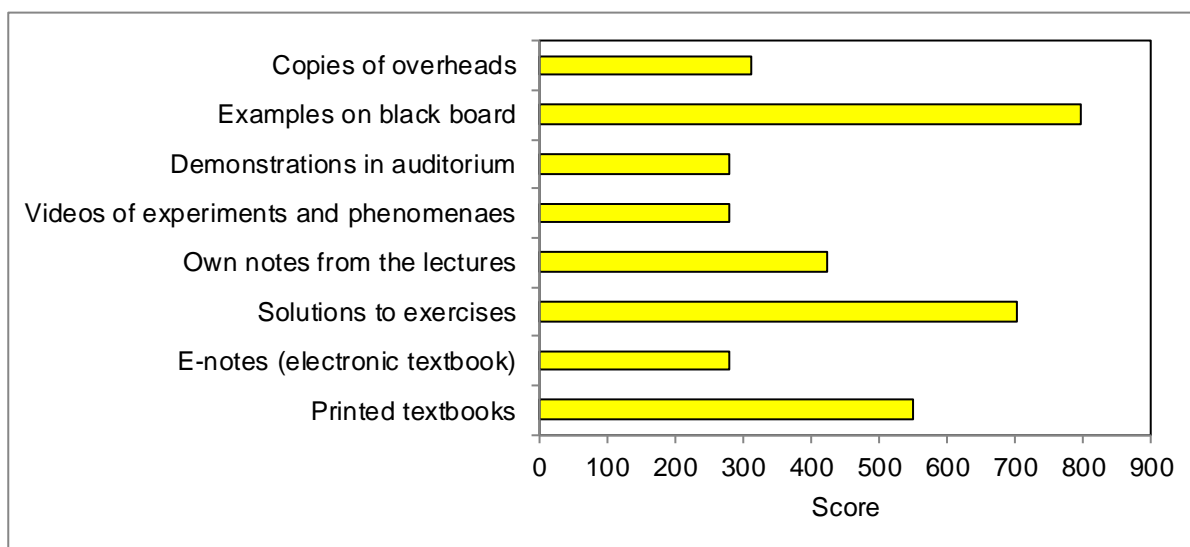


Fig.1. Questionnaire to the students in 2011 [3].

Question: Which resources did you benefit most from ? (The score is the sum answers, which range from 1=lowest to 10=highest)

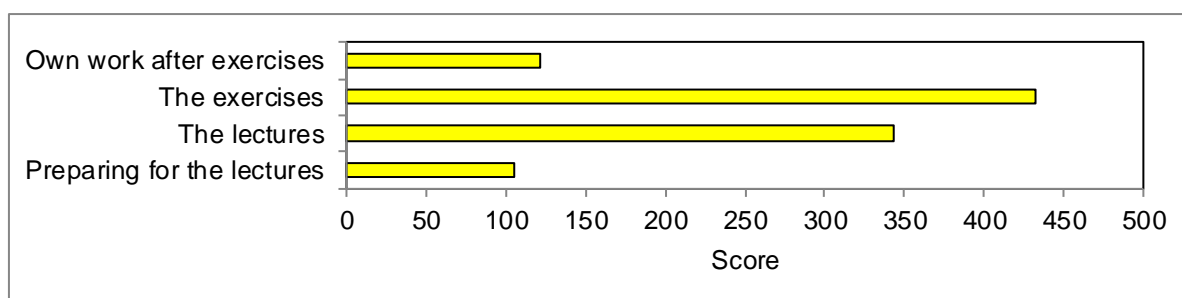


Fig 2. Questionnaire to the students in 2011 [3].

Question: Which activities benefited you most ?

The decision after this was to increase the number of examples at the lectures and the number of exercises in the courses. The number of available exam sets and model solutions was increased as well (as these were expected to be used to a large extent).

It was also decided that the teaching material should be developed to support a more efficient self-study, as this should form the major part of the students learning activities. This development will be carried out in steps, where the first three steps will be:

1. Develop a course material suitable for self-study (spring 2012).
2. Run a semester with mandatory self-study (autumn 2012).
3. Run a semester with optional self-study (spring 2013).

Each of the three steps are described and the steps results presented in the following. Each step is evaluated at the end and the actions in the next step identified. The evaluations will be based on performance at the exam, registration of attendance at exercises, course evaluations, questionnaire and numbers of hits on homepage and on Youtube.

Additional steps are expected after these three steps, but can only be identified and planned after the experiences from the initial three steps have been collected and evaluated.

3. STEP 1: DEVELOP COURSE MATERIAL SUITABLE FOR SELFSTUDY

This started with the development of a homepage www.concretestructures.byg.dtu.dk to contain all teaching material, including overhead copies, exercises with detailed solutions and exams sets, patches and the E-learning materials as videos of lectures, E-presentation and E-examples. The material will be available to everybody and can be used freely (regulations require the lectures to be in Danish, which probably limits the usefulness to Scandinavians).

All lectures (based PowerPoint and using the blackboard for examples etc.) are video recorded during the semester; just as all PowerPoint presentations are turned into E-presentations (videos produced from the PowerPoint presentations with speech and animation). Both types of videos are placed within hours on Youtube, account ConStruct2800Lyngby.

The blackboard examples and others are produced as E-examples with a SmartPen and are available for download from the homepage as pdf-files with both animation and speech. This separate the level of information the students must provide in their exercises clearly from the additional explanations from the teacher, just as in a traditional blackboard example. These three types of E-learning materials provide the students with an individual choice of which E-learning materials, they prefer to use for their learning.

The introduction of these E-materials received very positive comments from the students during the course evaluations. A questionnaire [4] among the students shows (181 responses), that they use the homepage and the three types of teaching material (videos of lectures, E-presentation and E-examples) significantly (Tables 3, 4 and 5). Their personal choices of E-materials reveal no clear pattern, and the students seem to mix the three types in individual ways to suit their learning style.

Table 3. Questionnaires [4], [5] on use of E-material. Question: “How much did you use the following E-material ?”.

Answer	Videos of lectures		E-presentations		E-examples	
	S2012	A2012	S2012	A2012	S2012	A2012
Very much	14%	20%	10%	0%	16%	6%
Much	15%	33%	18%	44%	25%	31%
A little	35%	40%	35%	38%	36%	63%
Not at all	36%	6%	37%	19%	23%	0%

Table 4. Questionnaires [4], [5] on use of E-material. Question: “How much did you use the following material ?”. Note 1: The values are estimated by combining the answers to two different E-materials in the way that e.g. “much use” of videos of lectures plus “much use” of E-presentation adds up to “very much use” of the sum of the two material.

Answer	Sum of videos and E-presentations(1)		Sum of E-presentations and E-examples (1)		Sum of videos and E-examples ⁽¹⁾	
	S2012	A2012	S2012	A2012	S2012	A2012
Very much	25%	25%	27%	25%	25 %	25%
Much	19%	50%	24%	50%	19%	50%
A little	37%	25%	31%	13%	37%	25%
Not at all	19%	0%	18%	13%	19%	0%

Table 5. Questionnaires [4], [5] on use electronic teaching material. Question: How much did you use of at least one of the three types of E-material?” (based on combinations of individual responses).

Answer	S2012	A2012
Very much	28%	25%
Much	32%	63%
A little	27%	13%
Not at all	13%	0%

The counters on the Youtube account (Table 6) shows a fair use of the videos (1/student/week) during the semester and a significant increase during the last week before the exam (> 4 videos/student/week). Responses to questionnaire [4] reveal that the students see no need for additional options to support their individual learning style during their self-study.

Table 6. Use of videos and E-presentations (S2012: Regular course, A2012: Concrete café, S2013: Regular course). Note 1: Exam due later.

Visits on Youtube account	Total visits weekly			Weekly visits / student		
	S2012	A2012	S2013	S2012	A2012	S2013
Semester	261	203	346	1,13	8,13	1,49
Average week in semester	261	203	346	1,13	8,13	1,49
Week before exam	990	261	(-) ¹	4,30	10,44	(-) ¹

The student performance at the exam seems to be unaffected by these new options for self-study (Table 1). Still a clear correlation between number of students attending the exercises and number of students passing the course seems obvious. This could be interpreted as due to a learning/social culture, in which the students prefer to work together with their friends during the exercises and choose to attend the lectures as preparation for the exercises. The questionnaire [4] verifies (Table 7), that the students use former exam sets extensively during the repetition period.

The evaluation is that the teaching material is suitable for self-study. The E-materials should be used by the students at the “concrete café” in the following semester. An external evaluation an external teaching institute for professional engineers continued education to offer the course as a paid self-study course with a DTU-exam and diploma, where the materials are supplemented with mini-seminars planned outside normal working hours.

4. STEP 2: HAVE A SEMESTER WITH MANDATORY SELF-STUDY

This is carried out in the lecture free semester with the “concrete café”. These students may now carry out self-study in the traditional manner or they may use the new options (lectures videos, E-presentations and E-examples).

The records (Table 2) show that much fewer students attend the concrete café in this semester (which may be due to the students having other activities in that period). The counters show that the students use the E-material significantly (Table 6 shows > 8 videos/student/week). The questionnaire [5] show (16 responses) that their preferences (Tables 3, 4 and 5) in which E-materials they actually use are as divided as in the previous semester and that they use the old exams sets as much as the other students.

Table 7. Questionnaires [4], [5]. Question: “How many exam sets did you go through?”.

Answer	S2012	A2012
>75 %	51%	50%
50-75%	29%	25%
25-50%	16%	19%
<25%	5%	6%

The percentage of students passing the course was increased compared to the past (Table 2). This indicates that the E-material is a major advantage for these students. It is not possible to document a firm conclusion as there are only data from one exam period. The logged data shows that the new E-materials are used significantly by the students and provide new and important elements for their learning approach.

The questionnaire [5] reveals that the students also find that the materials cover all their needs. A monthly question period with the teacher could, however, be an improvement and should be tried next autumn.

The next semester should use lectures and exercises as usual. The next semester will also test the effect of having the previous semesters lecture videos, the E-presentations and all the E-examples available already at the beginning of the course

in order to test a semester with optional self-study and a chance for preparing for class by seeing the last years lectures. The lectures will again be recorded in order to test if this is required each year or could be recorded less frequently.

5. STEP 3: HAVE A SEMESTER WITH OPTIONAL SELF-STUDY

This step is carried out in this spring semester (spring 2013). The course is taught as a year ago, but has the added benefit from having all the E-learning material available at the beginning of the semester.

The course evaluations show that the students are very pleased with the teaching and learning approaches and that they value the E-learning materials and they are starting to use these more than the students a year ago (Youtube hits in Table 6 shows 30 % increase from S2012 to S2013). The number of students attending the exercises is a bit lower than last year (Table 1), but this may just show a normal variation of the numbers. The exams are due in June 2013 after which a new questionnaire will be issued to check the student use of the resources and their benefits.

The individual students attending the exercises have been registered in 3 sessions with app. 1 month interval. These registrations will be compared to performance at the exam and other data and indicators and will be analysed in detail in order to determine students, who deviate from the expected performance at the exams and identify these students "best practice". It will also include a number of interviews with students in order to determine suitable actions.

6. SUMMARY AND RECOMMENDATIONS

The introduction of E-learning options obviously increases the student possibilities to establish their own learning self-study style and to use the material at a time of the students own choice. These options are used significantly by the majority of the students. The E-learning options are especially used in the repetition period before the exam.

The preliminary results indicate that it improves their learning in the self-study period significantly, although more tests are required before a conclusion can be fully documented.

There is still a clear relationship between the number of students attending the exercises in the spring and the number of students, passing the course. It is assumed that the learning culture among most of the students is such that they include the social aspect of being able to attend the lecture and do the exercises together with their friends. A detailed investigation and evaluation of the relations between the students attendance during the courses, their grades and their performance and choices is planned in summer 2013.

The next step 4 in the development of the teaching and learning in these courses will most likely focus on the exams sets and how these can be better used as a drive for the students learning, e.g. by diversifying the exam questions. It will also be considered how this change can be combined with e.g. an independent design exercise, used both as a learning tool by the students and as way of establishing an individual overview of the taught topic.

REFERENCES

- [1] Goltermann, P.: Renewing the teaching by interacting with the CDIO-projects, Proc.7th International CDIO conference, Copenhagen, Denmark.
- [2] Goltermann, P.: Fremtidens Betonfolk (The future concrete persons), presented at Danish Concrete Days 2011, published at www.danskbetonforening.dk
- [3] Hussmann, Peter: Summary of questionnaire responses. May 2011, DTU.
- [4] Goltermann, P.: Questionnaire after exam and prior to release of grades in June 2012, DTU.
- [5] Goltermann, P.: Questionnaire after exam and prior to release of grades in January 2013, DTU.