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## **INFLUENCE OF INTRODUCTION OF E-BASED DISTANCE LEARNING ON STUDENT EXPERIENCE AND PERFORMANCE**

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### **Abstract**

A new project based course offered by Arctic Technology Centre, Department of Civil Engineering, Technical University of Denmark (DTU) and Department of Bioscience, Aarhus University in collaboration, targets students from the whole circumpolar area. It was developed over a three year period from being taught in class to being taught 100% online. We evaluated the results by analyzing the students' performance and experience of the course during the three years. The students' performance increased over the period of transforming the course. Multiple choice quizzes showed to be efficient tools for the students' self-evaluation, while they did not contribute to their learning. Some contradiction between the group work format of the projects and the online teaching method was experienced by the students. Also student satisfaction decreased slightly - influenced by inconvenient features of the used learning management system, reduced instructor feedback and varying quality of the narration of the lecture videos.

### **1. Introduction**

At Arctic Technology Centre, Department of Civil Engineering, Technical University of Denmark (DTU), it is our vision to develop courses and educations for students and professionals aiming at or having a career in the Arctic areas. In some cases this requires participants to meet and have practical experiences with Arctic climate, infrastructure etc. However, in other cases the topic being taught is of more a theoretical character that does not necessarily require physical presence. In those cases it could be a great benefit for participants spread over the large and sparsely populated Arctic area to be able to take courses online and asynchronous from the distance due to the large distances and span of time-zones covered of the Arctic. Together with Department of Bioscience, Aarhus University we have developed our first master level course into a 100% e-based course and tested the course for distance learning. The title of the course is *Mineral resources in the Arctic: Environmental impacts*

*and technologies*. It is divided into two parts: one concerning land based mines, and one concerning offshore oil exploration. The main aim of the course is to teach the students to accomplish and critically evaluate an Environmental Impact Assessment (EIA) on mineral resource extraction/exploration projects in Arctic locations. To meet this aim, the students produce and evaluate EIA's themselves the following way: In groups decided by the instructors, they produce EIA's on fictive mineral extraction/exploration projects in arctic locations, - one for each part of the course, and they peer-review each other's EIA's in the format of a white-book, thereby experiencing some of the aspects in an actual hearing process. To support the students work on the EIA's, lectures and calculation assignments are given and literature is assigned. In this work we will sum up on the student performance and feedback during the development of the course from being classroom taught into being 100 % eLearning.

## 2. Course setup and development

The course development is summarized in table 1. The course ran initially in fall 2013 as in-class-teaching consisting of two hours of face-to-face lectures and two hours of instructor supervised group work each week during the 13 week period of the semester. A significant number of guest lecturers from industry were contributing to the teaching. The idea of developing the course into eLearning appeared after feedback on this round.

In fall 2014 the biggest difference was the significant increase in the number of students. To be able to give the increased number of students continuous feedback on their performance combined with our goal to develop the course into being e-based, we developed electronic multiple choice quizzes (MCQs) for each lecture. We made it obligatory for the students to test themselves in the quizzes, and we cut down on the number of guest lecturers.

Table 1: Course development and number of students. \* A White Book addresses concerns raised during a Public Consultation Processes.

Teaching method	year	no of students	Peer review of EIA's	Exam method
Classroom lecture + group work	2013	9	White-book* + oral presentation	MCQ + oral
Classroom lecture + group work + obligatory MCQs	2014	30	White-book* + oral presentation	Oral
Distance eLearning incl. voluntary MCQs	2015 Spring	5	White-book* + oral presentation by use of videolink	Oral
Distance eLearning incl. voluntary MCQs	2015 Fall	43	Anonymous peer review of EIA resembling white-book*	Oral

In spring 2015 the course was developed into being fully e-based. It was offered through the Learning Management System (LMS) platform Coursera on an internal DTU site only available to students whom were provided access. The course consisted of 33 narrated PowerPoint presentations on condensed topics lasting 10-20 minutes each, assigned reading material, instructions for the group EIA assignments and MCQs for each topic. Online discussion fora at the platform were used for communication between students and instructors and students among each other. The MCQs were now left voluntary and could be taken as many times as the students liked, and after having taken the quiz once, the students were able to see the correct answers. This time the course was provided as part of an Arctic semester where the students were located in Nuuk, Greenland. The instructors were placed in Denmark. The students attending the course were mostly biology students, whereas otherwise only engineering students have attended. In fall 2015 the course was again provided as 100% e-based, this time by DTU and with an increased number of engineering students, who were mostly physically present at DTU while some of them followed the course from the distance during part of the semester. In 2015 the white-book concept was implemented as much as possible into Coursera, though it was not possible to implement it as realistically, and also it was not possible for the instructors to view the comments given by the peers in a manageable manner, thus comments from the instructors were not given. On the other hand it was possible for the students to peer review as many reports as they liked, thus they could increase their learning and get substantial feedback from their peers.

### **2.1 Evaluation of students' performance**

In the first round of the course in 2013 the two EIA reports counted each 25% of the individual grade, while the exam, which was a 4 hour electronic quiz counted 50% of the grade. Due to an administrative error during the exam the students were offered a chance of re-examination: They were offered an oral examination, which four of the nine students attended. Through this oral re-examination we learned that the grading based on the EIA reports did not reflect their final level. Due to this, it was decided to continue with oral exams, while keeping the EIA's as obligatory assignments providing access to take the exam. This way we could also guarantee that the grades were given based on the student's personal skills. The examination of the students in Nuuk in spring 2015 was done via video-conference connection. Otherwise the students were able to show up on location. The same external censor was used except for spring 2015.

### **2.2 Methodology**

In order to evaluate the impact on teaching and students' learning various data was collected and a series of qualitative and quantitative studies were carried out. This included:

- The examination results for each individual student: The exams were graded according to the Danish 7-step scale (which is compatible with the ECTS-scale), -3 (F) and 00 (Fx), 02 (E), 4 (D), 7 (C), 10 (B), and 12 (A) [1].
- Web-based course evaluation results for all DTU course runs. Answers to the general course evaluation were provided by 5 of 9 students in 2012, by 13 of 30 students in 2014, and by 20 of 43 students in fall 2015. The answers may be biased as students with strong opinions tend to have a higher motivation for answering evaluations.

- Web-based exam evaluation for DTU course runs in 2014 and 2015 which 12 of 30 and 13 of 43 students answered, respectively.
- MCQ pre- and post-test results from 2014. The tests were given in classroom under instructor surveillance during the first and the last lecture of the course. The tests could not be retaken, and the right answers were not revealed to the students. The two tests were identical.
- A mid-term evaluation in fall 2015 addressing the students' perception of the eLearning and the module homepage in the learning management system (LMS).
- Statistical and access data from the Coursera platform, including the play statistics from the video server and access and usage statistics of the module homepage in the learning management system (LMS).

### 3 Effect of eTeaching on student performance

The grades given are shown in Figure 1. It can be seen that only very few students have failed the course and also that the average has increased from 7.2 (DTU average) in 2013 to 9.1 in 2015. It is our perception that the low number of students failing is due to the student centered active teaching method [2]. Only one student ever decided not to take the exam despite the fact the student had handed the assignments. It can be imagined that more students would have attempted to take the exam if the group assignments had not been obligatory – and that several of them would have failed or gotten a low grade. In evaluation of the effect of introducing eLearning on students' performance we compare the two course rounds with the most comparable students in terms of number and teaching format: 2014 and fall 2015. From Figure 1 it can be seen that the GPA increased after introduction of eLearning from 8.2 in 2014 to 9.1 in fall 2015.

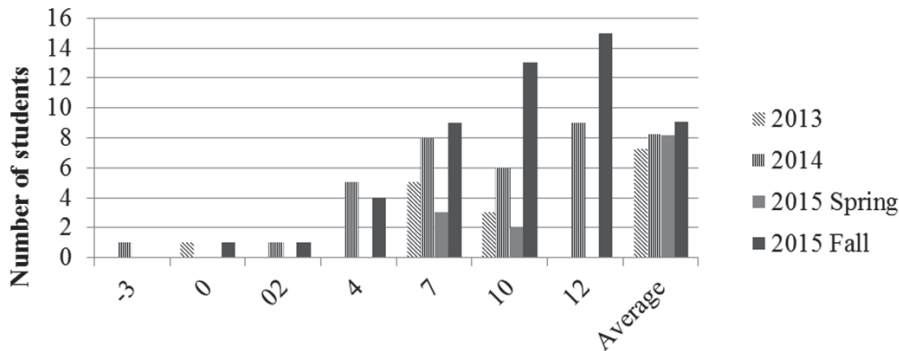


Figure 1: Grades given during the four runs of the course. 2013 and 2014 classroom, 2015 spring and fall: eLearning

Also the percentage of students receiving grades above 7 increased significantly (fig. 2). It may therefore be concluded that the students' performance improved by introduction of the eLearning despite the fact that the student-instructor contact time went down to almost zero

with in most cases the first personal meeting being by the oral exam. This effect was also found by Godsk [3]. In both studies, however, the course in question was the only eLearning course in the students' curriculum, thus other courses have provided platforms for the students' social interaction which has been found to be particularly important for students receiving online teaching [4].

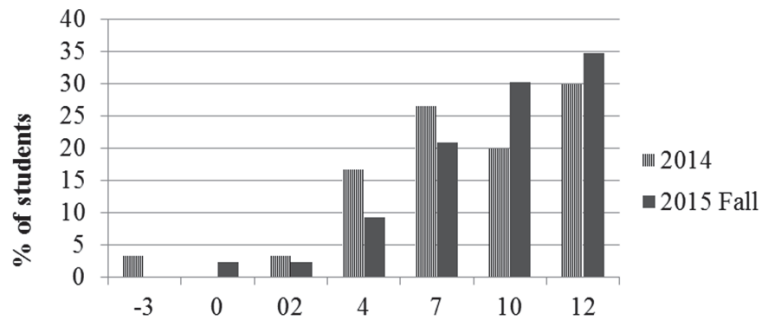


Figure 2: Percentage distribution of grades – comparison of 2014 (classroom) and 2015 (eLearning).

### 3.1 Use and usefulness of eQuizzes

Figure 3 illustrates the relation between the students' final grade and their performance in the pre- and the post-tests in 2014. The average performance in the test increased from 42 to 70% during the course period, and a good correlation ( $R^2 = 0,31$ ) between pre and posttest score existed. No significant correlation, however, existed ( $p=0,64$ ) between the initial performance and the final grade, while a significant relation ( $p=0,03$ ) was found between the post-test score and the final grade in the oral exam. In other words the course allowed for students with even very limited preconditions to raise their level and obtain a high grade.

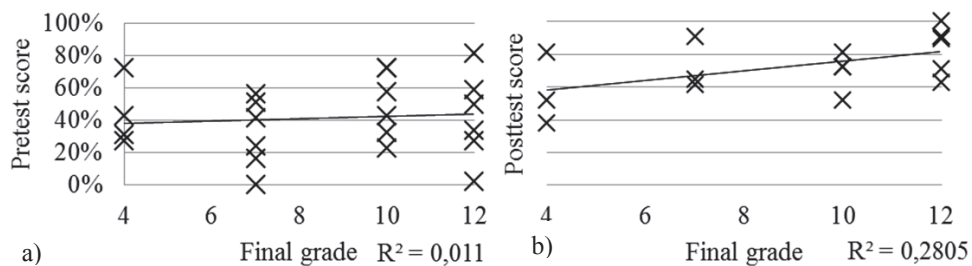


Figure 3: a) correlation between final grades and pre-test score; b) correlation between final grade and post-test score in the 2014.

Also it is evident that most students performed slightly better at the oral exam than at the post-test, which illustrates their increased learning during their preparations for the exam. Even better correlation ( $p=0,001$ ) was found between the final grade and the average quiz

result of all quizzes (latest submission result) (fig. 4b), while there was no correlation ( $p=0.26$ ) between number of quiz submissions and final grade. I.e. good grades could be obtained without handing in any quizzes, while not so good grades could be obtained even after a high number of quiz submissions. Thus the aim of the quizzes to inform the students on their individual performance throughout the course at any point of time was clearly met, while the MCQs did not in themselves improve the students learning.

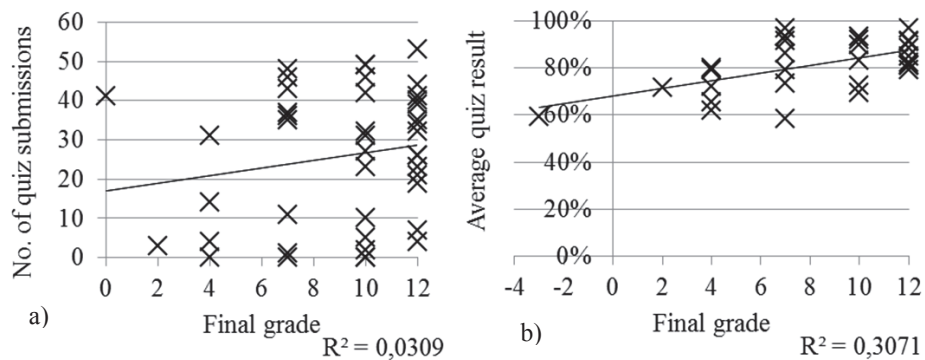


Figure 4: a) correlation between final grade and no. of quiz submission in 2015; b) correlation between average quiz result and final grade in 2014.

### 3.2 Use and usefulness of group EIA assignments

As the aim of the group assignments was to address the core elements of the course, and the lectures, quizzes and reading material was regarded support material, it is interesting to analyze how the assignment deadline affected the student activity on the other course tools.

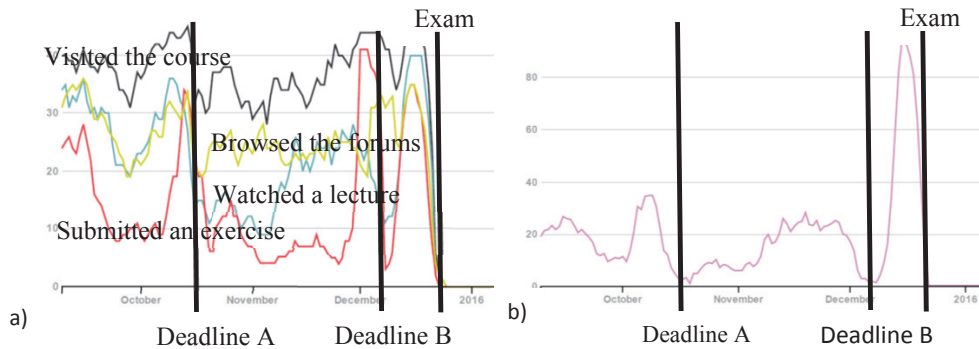


Figure 5: a) student activity during course period in fall 2015, b) unique number of video hours watched over a rolling 7-day period in fall 2015.

The first group assignment was to be handed in just after fall break in October (deadline A), and the other by the end of the semester – in the beginning of December (deadline B). Figure 5a with data from 2015, clearly show how both lecture watching, discussion fora browsing

and quiz submissions increased in the periods just prior to deadlines. An interesting observation is that in the second part of the course, it seems the students were initially exhausted upon handing in assignment A, while also that they had experienced the benefit of watching the lectures continuously rather than catching up just before assignment hand in, as lectures were watched more regularly during this period of the course. It is however clear from Figure 5b that the oral exam more than anything motivated the students to study. This again supports our impression that their level of knowledge had increased significantly between handing in the assignments and attending the exam (chapter 2.1).

#### **4 Effect of eTeaching on student experience**

When asked whether they felt the course was a good course (fig. 6a), the difference between the classical and eLearning versions is small, with tendency towards more satisfaction with the eLearning version. Fewer students, however, felt the eLearning encouraged their active participation (fig. 6b). No significant difference could be observed on the students' satisfaction with regards to the teaching material (fig. 6c). In the midterm evaluation of 2015 the students were asked whether they felt the workload would have been perceived higher or lower if the course had been taught in classroom. Most students answered that they imagined either no change or that they had saved time by the eLearning (fig. 6d). According to the same evaluation 23 of 30 students had a positive or very positive experience when they first entered the course page at Coursera; while 15 tells that their ability to attend the course lectures was improved compared to if the course had been live at DTU, and 14 that it was worse.

Some positive comments were given in the final evaluation in 2015 concerned eLearning e.g.: "We did not waste time for attending to the class and we could study any time", and "Flexibility with time is also nice". But also several negative comments were given, - most of which concerned the quality of the sound and the speed of the narration of the PowerPoint presentations, as well as some features of the Coursera platform which was developed for (massive open online) MOOC courses, and were experienced inconvenient for a closed course like this - e.g. that the deadlines were given in North-American times, and that the flexibility for instructors to allow for extended deadlines was very low; while not the concept of the eLearning in itself. One student noted that he/she would have preferred classroom teaching, several students commented that the group forming process and necessity of physical meetings was time consuming and contradictory to the eLearning concept. The instructors had imagined the young generation being experts in meeting and communication virtually, but it seemed not to be the case.



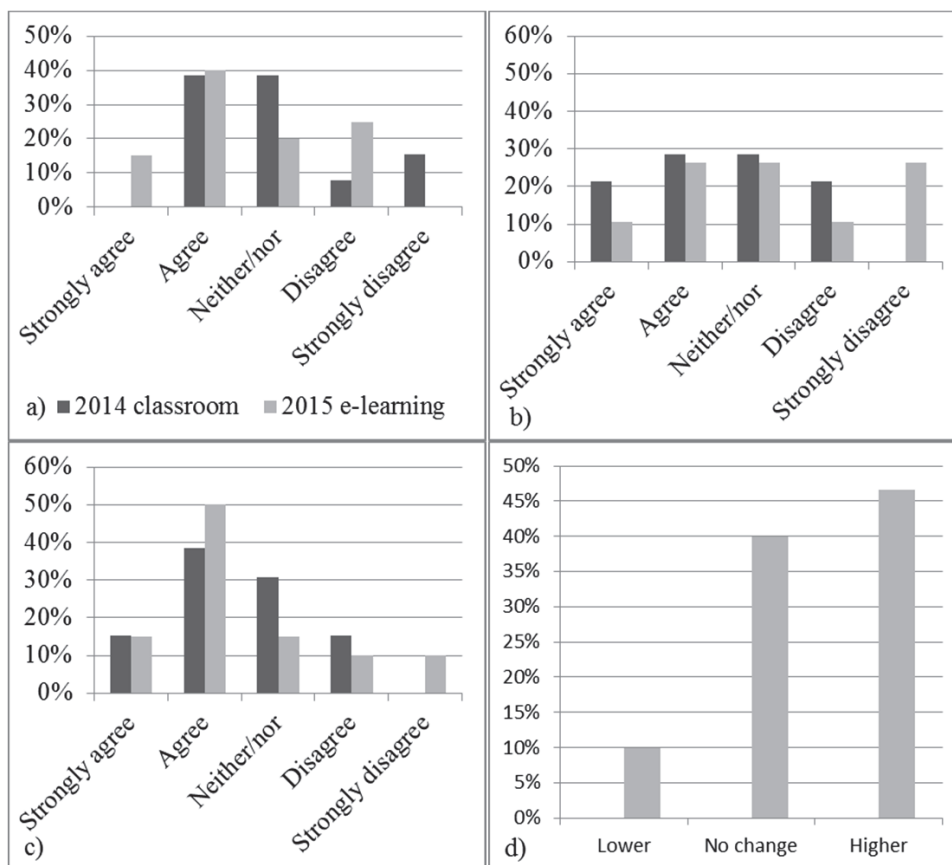


Figure 6: Students response in the course evaluation to the questions: a) "In general I think it is a good course" b) "I think the teaching method encourages my active participation"; c) "I think the teaching material is good"; d) "Do you think the workload would have felt higher or lower if the course lectures had been live at DTU?".

#### 4.1 Students perception on the use of eQuizzes as feedback tool

The purpose of the quizzes was to allow the students to evaluate themselves regarding their academic standing continually. Figure 4b and 4d showed they were a valuable tool for the purpose; still, however, less student felt the instructors "had clearly communicated their academic level of understanding" in 2015 compared to 2014 (fig. 7a). Despite the fact that the majority of the students in the midterm evaluation had expressed they experienced the quizzes to be a very good, good or satisfactory tool to inform you on your own learning (fig. 7b). This response is likely to be due to the lack of instructor feedback on the group assignments in 2015.

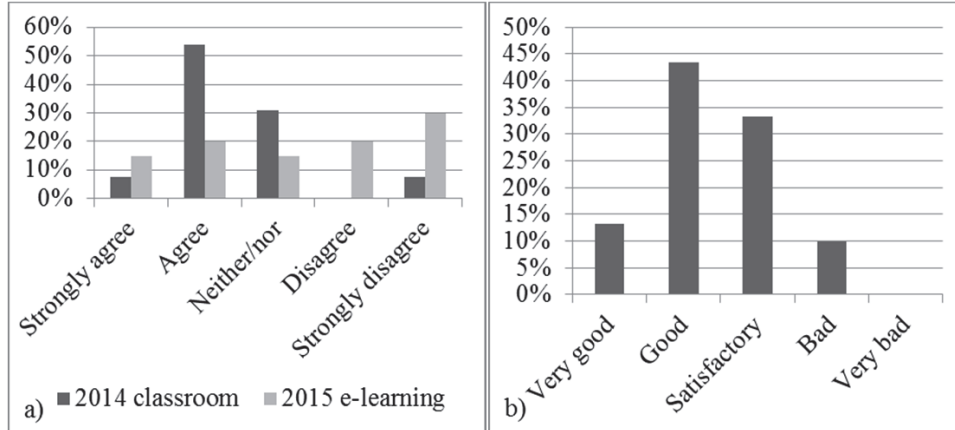


Figure 7: Students response in the course evaluation to the questions: a) “I think that throughout the course, the teacher/s have clearly communicated to me where I stand academically”; b) “How do you experience the quizzes as a tool to inform you on your own learning?”

#### 4.2 Students perception of the evaluation of their performance

Figure 8 illustrates the students’ perception of the agreement between the teaching method and the examination form. It might be theorized that an oral exam after an e-based course with no personal instructor-student contact would be perceived as contradictory. However, the survey result shows that most students find the examination in good accordance with the teaching, both in 2014 in 2015.

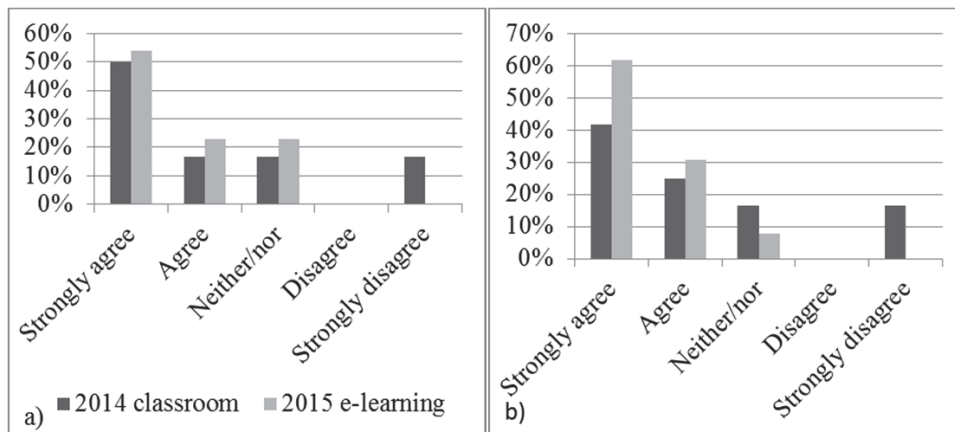


Figure 8: Students response in the exam evaluation to the questions a) “I feel that the examination corresponded to the teaching on the course”; b) “I think that the examination form and content corresponded to the learning objectives”.

In general the comments on the exam were positive: “We learned a lot during the courses and that we were asked” (2014 student); “oral exam is the best way to judge and check knowledge about the exam. So, I think it was very good” (2014 student); “questions focused exactly on the content of the course” (2015 student); “nice calm and good atmosphere. “Competent sensors, with good questions and good guidance towards showing knowledge of an extensive area” (2015 student). Two students, however, also felt they had a bad experience: “I am little sad about the exam grade because I could not show the teachers that I really studied during the semester but because of my stress and short answer I got low grade. I think it is not fair. But actually I appreciate the way they want to explain us our assignment. It is good” and “Some of the questions asked where a bit difficult compared to what I understood were the topics” (2015 students).

## 5. Conclusions and future outlook

Introduction of eLearning significantly improved students learning, but also reduced satisfaction slightly. The decrease in satisfaction was not mainly due to the eLearning concept itself, but due to the reduced amount of direct feedback from instructors on group work assignments, the lecture narration quality, as well as some features of the Coursera platform. The aim of the MCQ’s, to be able inform the students on their individual performance throughout the course at any point of time was clearly met, and most students also acknowledged this source of information. The MCQ’s were, however, not a tool for learning. Many students experienced the group work as contradictory to the eLearning method. Due to Courseras closure of the platform for courses other than MOOC’s, a shift to the Blackboard platform will be made in 2016, which may solve some of the issues. E.g. this platform allows for integration of lectures recorded via iSpring software which may improve the quality of the lecture videos. The group assignments will be transferred to less comprehensive individual assignments, while the white book peer- and instructor feedback will be developed to meet the students need for feedback as much as possible by use of the new platform.

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