Towards a blended approach to teach and supervise Electrical Engineering students

Final report

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3TU. CENTRE FOR ENGINEERING EDUCATION

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Table of contents

1. Context and justification of the project

The Electrical Engineering (EE) department has experienced a rapid increase in the number of students in the last years. The students' differences in prior knowledge and sometimes in disciplines and background demands a tailored-made approach to supervise students in learning concepts and to have them apply in problem-solving exercises. Moreover, due to the large number of the students and differences in learning styles it becomes relevant to pay attention to individual needs and study progress both at the undergraduate and graduate courses. Supervision of learning and the provision of feedback for learning[1]-[2] are the two key elements we would like to enhance in order to meet individual learning paths. In addition, we want to boost self-study time by involving students in meaningful assignments and providing just-in-time feedback. The integration of ICT tools will facilitate the process of making supervision and feedback efficient and tailored-made.

ICT tools can reinforce the power of giving feedback by:

- Focusing on individual needs;
- Supporting students to understand the concepts and applying them in solving problems exercises;
- Providing just-in-time feedback to the students;
- Enhancing study time.

We have introduced Oncourse, as an online platform for supervision, feedback and assessment.

[1] Hattie J. & Timperley, (2007). The Power of feedback. Review of Educational Research. DOI: 10.3102/003465430298487. *Vol. 77, No. 1, pp. 81–112*

[2] Kristina Edström, effectiveness of Teaching. Workshop, Dec. 2015.

2. Objectives, approach and outcomes of the project

2.1. Objectives

With this project we aimed at enhancing the learning process and study activities of the EE students at bachelor and master level by focusing on supervision and quality of feedback. The objectives of the project were to integrate forms of online supervision and feedback methods. In particular, we introduced:

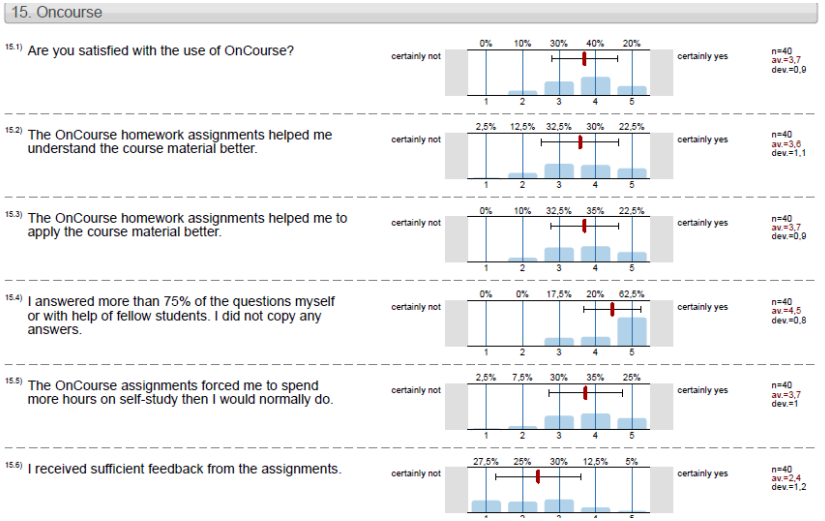
- Diagnostic test: The diagnostic test is meant to provide the students with enough information about deficiencies and lacunas regarding prior knowledge. In this context, we also wanted to use diagnostic tests as a form of self-assessment students to provide feedback on level of prior knowledge.
- Feedback: formative feedback and assessment for students but also for teachers to adjust instruction.
- Online tutorials: The students type in an answer and received additional information in the form of a tutorial.
- Maximizing self-study time: by providing assignments and problem-solving exercises both to apply the concepts and the newly-gained knowledge in the lectures. This will allow to flip-the-classroom and to focus on difficult topics in lectures and instructions.

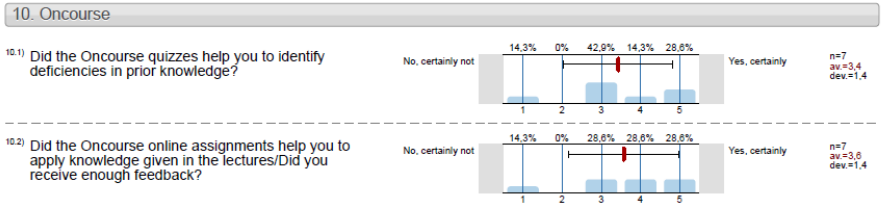
The selection of the different modes of feedback in the EE courses was determined after discussing the course context together with the teacher(s). The analysis of the courses will be based on the following:

- Categories of learning outcomes and assessment methods;
- Required compulsory prior knowledge and students' intake: EE students and from other disciplines; and,
- Number of students.

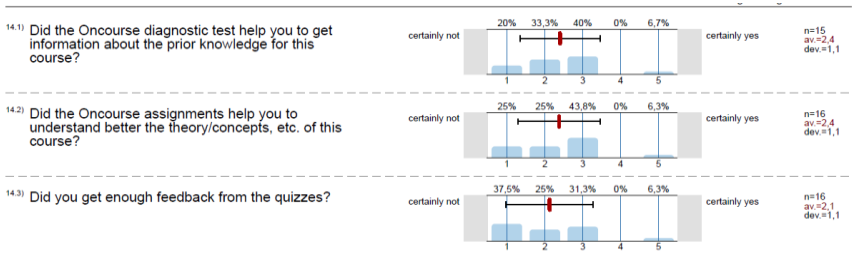
2.2. Approach and outcomes of the project

Pilot 1

Course Quarter	Analysis/Course context	Approach	Results
Intro Telecom (5ETA0)	• Learning outcomes: - Knowledge and application of **analog and digital communication systems** • Prior knowledge/type students: - There are a substantial number of pre-master students • Number students: 186	Objective 1: to inform students on entry level for the course and missing prior knowledge (i.e. Fourier transformation, etc.). Based on deficiencies additional educational material is provided. Objective 2: to keep students active and involved in course and content, and inform them on progress • Diagnostic test • Feedback quizzes to inform students on progress (every 2 weeks) • Assessment quizzes (30% of final grade – 3x quizzes 10% each) in the form of homework based on insight type of questions	Feedback for teacher: more specific attention is paid during instructions to some concepts in which students score lower in diagnostic test. Pass rates are (slightly) higher (~60%) in 2015/2016 than academic year 2014/2015 (55%) Instructions' attendance (slightly) higher than in previous year Students' satisfaction: 

Course Quarter	Analysis/Course context	Approach	Results
RF Transceivers 2: design (5SFE0) Q3	• Learning outcomes: - Understanding - Apply - Design • Prior knowledge/type students: - International students missing basic knowledge which is required for course and exam • Number students: 20	Objective 1: Quizzes are designed to test entry level and to inform students missing prior knowledge in order to prepare them better for the final oral exam (i.e. Carrousel) (i.e. circuits configuration)	Teachers' satisfaction: • quizzes help students to better prepare for the oral examination (students fail less final exam) • students are aware of the missing knowledge from the beginning of the course and additional hints/materials to prepare • it is not completely possible to compare this GS course with previous master course as there are differences in ECTS and number of topics. Students' satisfaction: 

Pilot 2

Quarter	Analysis/Course context	Approach	Deliverables & outcomes
Telecommunication systems (5XTA0) Q4 -	• Learning outcomes: - Understanding and apply • Prior knowledge: - Lacunas in conceptual understanding • Number students: 71	Objective 1 : o have a preliminary diagnosis of students' entry level in terms of prior knowledge; Objective 2: - Integrate online Oncourse assignments as a mean to: o learn students concepts; o have concepts to be applied in practical exercises; o provide feedback on progress; o use feedback to improve face-to-face instruction time by recalling concepts which are not yet been learned.	The teachers are satisfied with the online quizzes approach to learn concepts. They used this online platform to enhance the quality of self-study time and support students to applied understanding in solving practical exercises by providing immediate feedback. According to the teachers, this pilot was positive and future plans include an increase in the number of bi-weekly quizzes in order to have students practice more the understanding in the practical exercises. Although this approach support students' to learn concepts, students still considered that the quiz-approach needs to improve in several means: first of all, the diagnostic test questions need to be reformulate to test the needed prior knowledge. Likewise, the quiz questions need to focus on understanding concepts and the application of this in assignments. Finally, an improvement on the type of feedback the students receive from the quiz answers needs to be functional in order to provide just-in-time information to learn from mistakes. Pass rates are slightly higher than in previous year (~55%) 

Pilot 3

Quarter	Analysis/Course context	Approach	Deliverables & outcomes
Wireless communication (5LPA0) Q2 - Academic year 2016/2017	• Learning outcomes: - Analyze, apply and design • Prior knowledge: - Students with different background/disciplines • Number students: 32	Objective 1: Diagnostic test to provide information about missing knowledge Objective 2: Supervision of students' progress and feedback (weekly *Oncourse* quizzes)	There are no results available yet as this course run at the time of writing this report in Q2 academic year 2016/2017

3. Reflection and lessons learned

The main rationale for this project was to experiment with feedback and supervision methods. To enhance feedback and supervision we have introduced Oncourse, a Moodle online platform, as an IT-tool to support online monitoring of students. The innovative character of this project does not lie in Oncourse itself but in the didactical elements accompanying the redesign and/or slightly adjustments in the course to improve feedback and supervision. Each course had therefore a specific design approach ranging from including weekly practice and quiz questions to bi-weekly monitoring short quiz tests. A common factor throughout all courses was the diagnostic test aiming at identifying deficiencies and misconceptions at an early stadium.

All these experiences have been successful when it comes to creating small innovations in the courses that bring about a better understanding, both for the teaching staff and educational advisors, education and examination committees, of the possibilities of using IT-tools in education to provide feedback and to supervise students. However, it becomes extremely difficult to draw conclusions on the elements influencing the success as it is not possible to link automatically this success to higher pass rates, conceptual understanding or to an increase in attendance to the instructions. The reasons behind are two-fold: first of all, all pilots in this project are still 'under construction' and are not complete yet. In other words, the pilots consist of little adjustments in the form of quiz questions to identify prior knowledge and remediate the deficiencies and monitoring the students' (bi-) weekly progress. However, no major changes have been carried out regarding for instance the set-up and didactical approach of instructions and alike. In addition, not all courses include the same type of feedback, in the form of tutorial, of the courses. These elements are already the actions identified for future interventions in the courses, by the way, to keep improving the courses. Secondly, there are other relevant issues related to, for instance, the place of the courses in the curriculum, content and number of credits among others, that may have played a role as well upon which we have no influence regardless all didactical approaches we have introduced in the courses/pilots.

A few lessons learned from these pilots are summarized below:

- Results of diagnostic test must be used to remediate deficiencies by providing additional educational material to make students aware of missing prior knowledge and to help them reach the expected level in short time;
- Frequent feedback from quizzes must be used to enhance and adjust education. This can be done by emphasizing and explaining students' mistakes during lectures or instructions;
- IT-tool do stand alone. These are a core element of the instructional design of a course and must be applied together with a didactical approach.

Moreover, although efficiency was not considered to be an element to experiment with in this project, teaching staff confirm that it saves time in correcting assignments and tests.

From students' perspective, we confirm that receiving prompt feedback and frequent supervision on progress leads to students' satisfaction, in most of the courses. There are also some little differences in study success in comparison to previous years thanks to the introduction of IT-feedback and supervision tools. However, we cannot strongly ratify this finding.