

# Lecture Models in Electronics and Electrical Engineering



T. Winterstein<sup>1</sup>, F. Greiner, H. F. Schlaak<sup>1</sup>, L. Pullich<sup>2</sup>  
<sup>1</sup>Institute of Electromechanical Design  
E-Learning Center  
<sup>1,2</sup>Technische Universität Darmstadt  
Darmstadt, Germany  
{t.winterstein, leif.pullich}@emk.tu-darmstadt.de

**ABSTRACT:** *Through this paper we have presented an approach which is blended learning that use lecture modules aimed for more users. The proposed system is more flexible and the users can access to exercise solutions that allow for continuous learning. In our approach interactive animations and quiz play an important role.*

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## 1. Introduction

In this paper we present the blended learning concept of the basic course “*Introduction to Electrical Engineering*”, provided by the Institute of Electromechanical Design at the Technische Universität Darmstadt. The course is attended by about 1000 undergraduate students of four study programs, mainly mechanical power engineering. Before 2009 the lecture was organized traditionally, offering 4 hours of lecture and 2 hours of supervised exercise groups each week. The lecturer used three overhead projectors in parallel to show slides and write down mathematical derivations and sketches. For preparation and self-study there were printed lecture notes. The exercises contain technical assignments of tasks for preparation at home and discussion with student assistants during the exercise group. At the end of each week hand-written solutions to the exercise were provided for download. News and organizational information were available on the lecture homepage. The lecture was finished by a written exam of 2.5 hours.

In the year 2008 problems with the traditional concept increased:

- a) The large amount of students from various courses led to overlapping timetables, which complicated the attendance for the students
- b) The students, coming from various courses of study, provided different mathematical and physical knowledge
- c) The quality of the overhead presentation was considered poor, hampering the knowledge transfer
- d) A mass of comprehension questions arose and the lecturers found themselves flooded by e-mails

e) Exam results were poor, the lecture intimidated the students

Furthermore, for 2009 the exam date was moved from the sixth to the second week of the lecture-free period, dramatically shortening the preparation time for the students. This led to the development of a blended-learning concept first established in 2009 and constantly improved until 2011.

## **2. The Blended-Learning Concept**

Three main aspects were taken into consideration for the new concept: First, providing all-time accessible material, that follows the curriculum and can be autonomously as well as repeatedly used, allows self-study according to the individual skills and background knowledge. Second, new and different learning elements shall create an incentive to continuously stick to the lecture and lower the inhibition threshold to electrical engineering. Third, the administration effort needs to be kept low enough for one person to manage the lecture.

### **2.1 Lecture-accompanying material**

Positive impact on the learning performance and a high acceptance of the students, not leading to a decrease of audience are reported for video podcasts [1]. So in a first step, the lecture is recorded and cut into podcast-like videos of the curriculum's chapters (about 20 min). The videos are published online in the learning-management-system Moodle later the same day. They are available as stream and download. As a consequence, overhead lecture is replaced by PowerPoint presentations, where the lecturers write down mathematical derivations on partly prepared slides on tablet PC.

In a second step, the handwritten solutions to all weekly exercises are supplemented by recordings of about 2 h each, providing the solution from the approach up to the results. This is especially suitable at early stages of skill development [2] and allows full understanding of the thoughts necessary for engineering tasks. Thus, students can focus on individual difficulties maintaining the autonomous learning process.

Flexible access to recordings and solutions can tempt the students to concentrate all learning activity on the exam phase [3]. To avoid this, weekly online-tests, consisting of 5 multiple choice or drag-and-drop questions, have to be passed, prior to accessing the solutions (hand-written or recorded). Thus a weekly incentive and a multi-media learning experience are generated, giving immediate feedback of the students' skills.

An officially administrated message board for the students to ask questions and the lecturers to provide answers for the public completes the lecture-accompanying material.

### **2.2 Amendatory material**

Apart from the weekly material, amendatory learning activities are provided, to make the students actively participate in the learning process and thus increase their motivation [4]. Interactive flash-animations let the students get in touch with important logical interrelations and physical laws. A complementary video section illustrates applications and shows the practical relevance of the curriculum. Finally, a quiz following the example of "*Who wants to be a millionaire*" with 140 multiple choice questions is included to add a playful aspect [4] and give another option for direct feedback.

### **2.3 Administrative effort**

All material and activities related to the lecture are integrated into one Moodle course. This comprises the learning material, a news section, general information and organizational tools such as registration for exercise groups or access to exam results. The concentration of all material on one central platform enables one person to administrate the lecture, making it possible to provide an extensive amount of learning material at normal personal and structural cost.

## **3. Evaluation**

Evaluation results and user access statistics show good acceptance and a significantly improved learning behavior since the introduction of the blended-learning concept.

In course evaluation the average overall perception, including all classroom and online aspects increased from 2.55 to 3.9 on a 5-degree Lickert scale (see Figure 1) since the introduction of the blended-learning concept in 2009. The assessment of specific

aspects is shown in Table 1.

Attendance of the weekly exercises was strongly affected. In 2008 more than 100 % of the exam participants (students we assumed to actively attend the course) attended the first exercise, decreasing to about 40 % until the last exercise. Since the change of concept no more than 60 % attended the exercise at all (see Figure 2). We consider this as a sign for the strong need for an autonomous and individual learning process that could be met with lecture and exercise recordings.

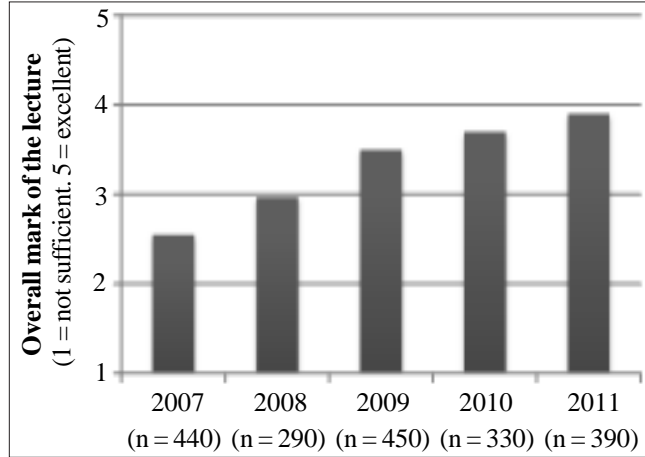


Figure 1. Overall mark of the lecture (5-degree Licker scale) over the years

	2008	2011
Overall quality of the material for practice	2.7	4.2
Legibility of the presentation	2.7	4.4
Relation between theory and practice	2.5	3.6

Table 1. Comparison of Evaluation Results on a 5-Degree Lickert Scale (as Figure 1)

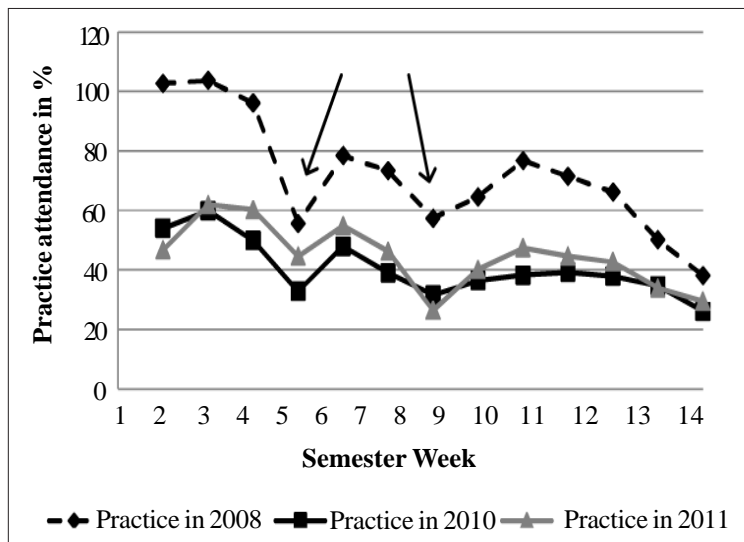


Figure 2. Practice attendance in % of the year's exam participants for the years 2008, 2010 and 2011

As another indicator for a successful concept we consider the ratio of exam registrations and actual participants. Despite increasing course size, the ratio increased steadily from 65 % of participation in 2008 to over 80 % in 2011 (see Figure 3). We interpret this as lowering of the inhibition threshold to do the exam and reduction of intimidation of the course.

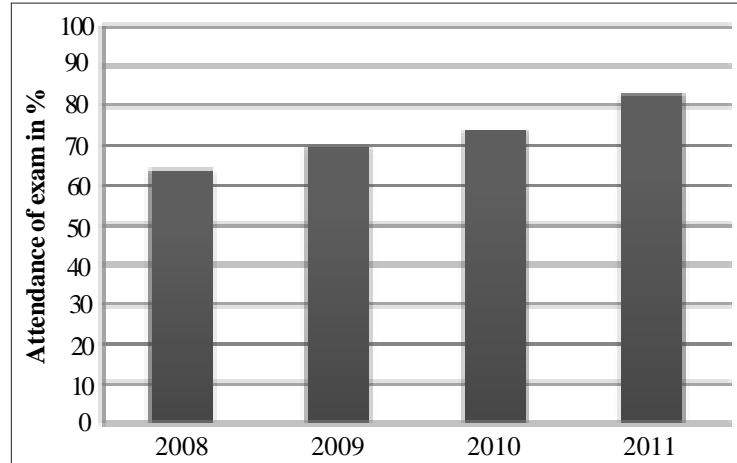


Figure 3. Attendance ratio of exam in %

#### 4. Conclusion

In this paper we present a blended learning concept for basic lectures in engineering studies with large audiences. Lecture and exercise recordings are used for flexible and individual learning, weekly online-tests prior to the access to exercise solutions allow for continuous learning. Interactive animations and a quiz as activating and playful parts lead to a deeper involvement of the students and strongly improved evaluation results.

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