Improving study skills by implementing peer to peer lecture films

Anja Pfennig and Paul Hadwiger

Abstract: *First year students of mechanical and automotive engineering are required to take 2 classes in Material Science at HTW Berlin. It is believed to be one of the more complicated subjects because the scientific background taught is not known from school or job training. Laboratory exercises accompany the education, but basic knowledge upon theory is necessary to work practically. Lecture films show the laboratory routine prior to lab hours and show students what they are going to experience and learn. These films were initially inspired by students and conducted during a one term semester project supervised by lecturers and film experts. It was found that students watching the films were prepared better and gained more knowledge during practical work than those who did not have access to the films. The grade average taking into account all 5 different experiments was slightly increased. It seems that watching the introductory films lead to more download activity and actual studying of the lectures provided to prepare the experiments and furthermore lead to better testing results.*

Key words: *peer to peer, lecture films, material science, blended learning*

INTRODUCTION TO THE CONCEPT OF A MATERIAL SCIENCE LAB COURSE

Material Science for mechanical engineering students at HTW Berlin is taught via the "design-led" teaching approach (figure 1) [1, 2]. Because the motivation by the challenges of the design is often lost in the conventional "science-led" teaching approach, the "design led approach" faces the engineering product, introduces its properties and later relates these to microstructure, atomistic structure and progresses to the physics and chemistry of materials. Therefore the teaching goal is the understanding of material science, but moreover to educate students and prepare them for their role as a maker of things [1].

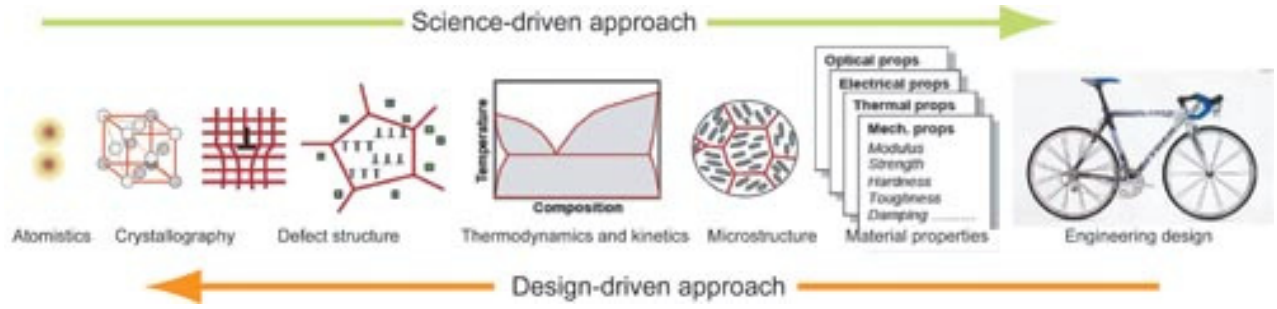

Fig. 1: „science-led-approach" and „design-led-approach" [1]

Lecture information and a wide range of teaching materials are provided in the moodle-based material science course [3]. This course basically addresses first year students of mechanical engineering, economical engineering, and automotive engineering. The concept follows a blended learning scenario where scientific backgrounds are self-studied via online-lectures. These small units, micro-modules, have precise titles and summarize the most important issues necessary to follow lectures and conduct laboratory experiments.

Students enrol into HTW applied university come from multiple different educational backgrounds, which is a benefit and a great challenge at the same time. It is necessary to study the scientific background of material properties to understand the material test results gained in the lab course. Discussions are encouraged, but these studies have to be done by the students on their own. Therefore a great variety of teaching material is provided. Mindmaps summarize the content of the micro module lectures. Micro module lectures combined with self-testing questions cover the most important issues. Web Based Trainings (WBTs) offer individual studying and demonstrations enhance memorizing and

understanding. Short course mindmaps aim at memorizing technical terms and understanding the correlation of the micro modules. Full content self-tests as well as assignments with worked solutions allow for students to control their learning progress and for the lecturer to assess skills and knowledge. Still, so far students did not find these appealing to pick and study properly when preparing for the lab course. Hence, most lab courses were very challenging, often chewy and disappointing for lecturers. The joy of hands on courses could not be felt. Based on students` initiative films were produced to make materials science lectures come to life.

FILMS IN TEACHING MATERIALS SCIENCE AT HTW

Up to now there are 9 lecture films ready available on moodle HTW and youtube (https://www.youtube.com/playlist?list=PLUOlZMSZYz5ww5xRMQdzIUooNifYEemvZ) for students enrolled in material science classes:

Corrosion

- Introduction (10:10 min)
- Precipitation of iron hydroxide (rust) (2:50 min)
- Design for protection of corrosive attack (1:17 min)
- Cathodic corrosion protection (1:09 min)

Materials Testing (figure 1)

- Heat treatment (3:08 min)
- Ultrasonic testing (1:22 min)
- Microstructure (1:44 min)
- Tensile strength testing (1:19 min)
- Hardness (3:09 min)

Fig. 1: Materials testing lecture films in material science blended learning course

In progress: composites

- *introduction*
- *mechanical properties: the paradoxes of the fibre*
- *composites in aeronautics*

PEER TO PEER APPROACH FOR LECTURE FILM MAKING

Class results indicate that involving students directly into teaching activities can be very effective in getting students to engage in critical thinking [4,5]; thus, producing deeper learning outcomes [6,7]. Well known methods are for example: "think pair share", peer instruction [8], reciprocal peer tutoring [9] or undergraduate teaching assistance [10].

Since 2014 the 3I-model has been developed within the externally funded OLP project at HTW Berlin (Online Lehre Plus /Online Teaching Plus) [11]. This model defines video as a channel in teaching by its intention:

inform, instruct, give impulse.

Both, the screenplays of the students and the peer-to-peer lecture films produced are good examples how to instruct in an effective way especially regarding the peer-to-peer aspect.

3I Model Overview

- **Information**
  Short video inputs to replace the traditional frontal type of teaching basic knowledge for inverted classroom setups [11].
- **Instruction**
  "How-to videos" to qualify students to work with machines/setups respectively theoretical models for quantitative or qualitative research.
- **Impulse**
  Short documentary videos for advanced students serve as an additional motivation and affirmation. These videos encourage the individual to critically examine his or her own views and promote cross-border collaboration.

All the teaching benefits are included when students are involved in the film making according to the peer to peer teaching approach which applies well for films as lecture. Most important issue for effective operation of the lecture films is that the concept was based on student`s experience and their special needs when preparing for the graded lab courses. Therefore 6 students worked on a full concept and implementation and integration of the lecture films in the moodle course available to all students taking lab courses in material science. The short films introduce the specific labs, the task and the working routine without presenting results or findings. Voices were only used to support the pictures and explanations were given from the background. The lecture screen play was proof read by lecturers and the film making was supervised by an OLP-film team of the HTW [11].

The same procedure was applied for the making off the films introducing corrosion. Here a screenplay similar to german educational programs, such as "Willi will`s wissen" or "Wissen mach ah" or "check 1" was produced to get into the subject. 3 student actors were asking and answering different questions. This format was later evaluated as less beneficial for lecture purposes because the introductory film was too long and then way too much information was given. Sequences of 1 to 3 min were found to be beneficial in terms of increasing the students` knowledge prior to lectures. Therefore 3 short films were extracted from the introductory film to get deeper into specific questions or to give the opportunity to focus on these only.

EVALUATION AND FIRST RESULTS

To introduce the laboratory experiments lecture films appeal to many students. These films do not provide scientific background information, but make students curious and encourage them to search for insight. Films are therefore a probate media to encourage students to self-study und gain good results during lab courses and theoretical background testing. These films may also provide excellent requirements when inverting the classroom [4-7]. Is seems that watching the introductory films lead to more download activity and actual studying of the lectures that were provided to prepare the experiments. Therefore we find that students watching the films were well prepared when they enter the lab course once they had access to the film material. Notes and handwritten summaries were brought along, mindmaps and summary sheets were downloaded and memorized. The additional learning material helped the students to understand the science behind the results they produced in the lab. Pre-test results prior to lab entrance were improved and the groups worked homogenously with lots of inspiration. The students asked important questions, initiated discussions and even those students, who did not attend the lecture

classes increased their understanding of complicated correlations. Also, lecturers taught lively students eager to dispose their knowledge and learn more of the details.

This concept was applied first in spring semester 2015. Therefore there is only little data with no statistical significance available evaluating the learning outcome of the students. However, the students involved in the making of the film, found that they gained substantial knowledge in materials testing, the reason for applying a specific testing method and the results. The students found themselves capable of choosing the suitable parameters and analysing the data to give profound information on the mechanical properties of the materials tested. Moreover the students were able to explain the test samples behaved the way they did during testing, which they have not been able to earlier when taking the course.

Combining the results obtained by mechanical engineering and automotive engineering students who took the lab course in spring semester 2015 to those who worked in the lab in fall semester 2014/15 the overall results slightly increased. The grade average in fall semester was: 1,92 (64 students) compared to the grade average in spring semester, where films were first introduced was 1,87 (84 students).

In general the students got better grades when watching the introductory films taking into account the different single experiment (table 1, figure 2). But, not all experiments were subject for better results, for example the grades for "hardening" was better in fall semester 2014/15 (table 1). This may be due to the fact, that for most students hardening was the first experiment of the semester and the films have not been taken as a serious method of preparing.

Table 1: Average grades resulting from different experiments 2014/15 and 2015

Hardness		**Heat Treatment**		**Microstructure**		**Ultrasonic**		**Tensile Testing**	
WS 2014/15	SS2015	WS 2014/15	SS2015	WS 2014/15	SS2015	WS 2014/15	SS2015	WS 2014/15	SS2015
2,05	2,25	2,01	1,83	1,86	1,78	1,81	1,67	1,97	1,83

Comparing the grades for single experiments more students received 1,0 or 1,3 in spring semester 2015 for ultrasonic testing, heat treatment and microstructural analysis. Therefore a slight shift towards better grades after watching and working with lecture films was noticeable (figure 2).

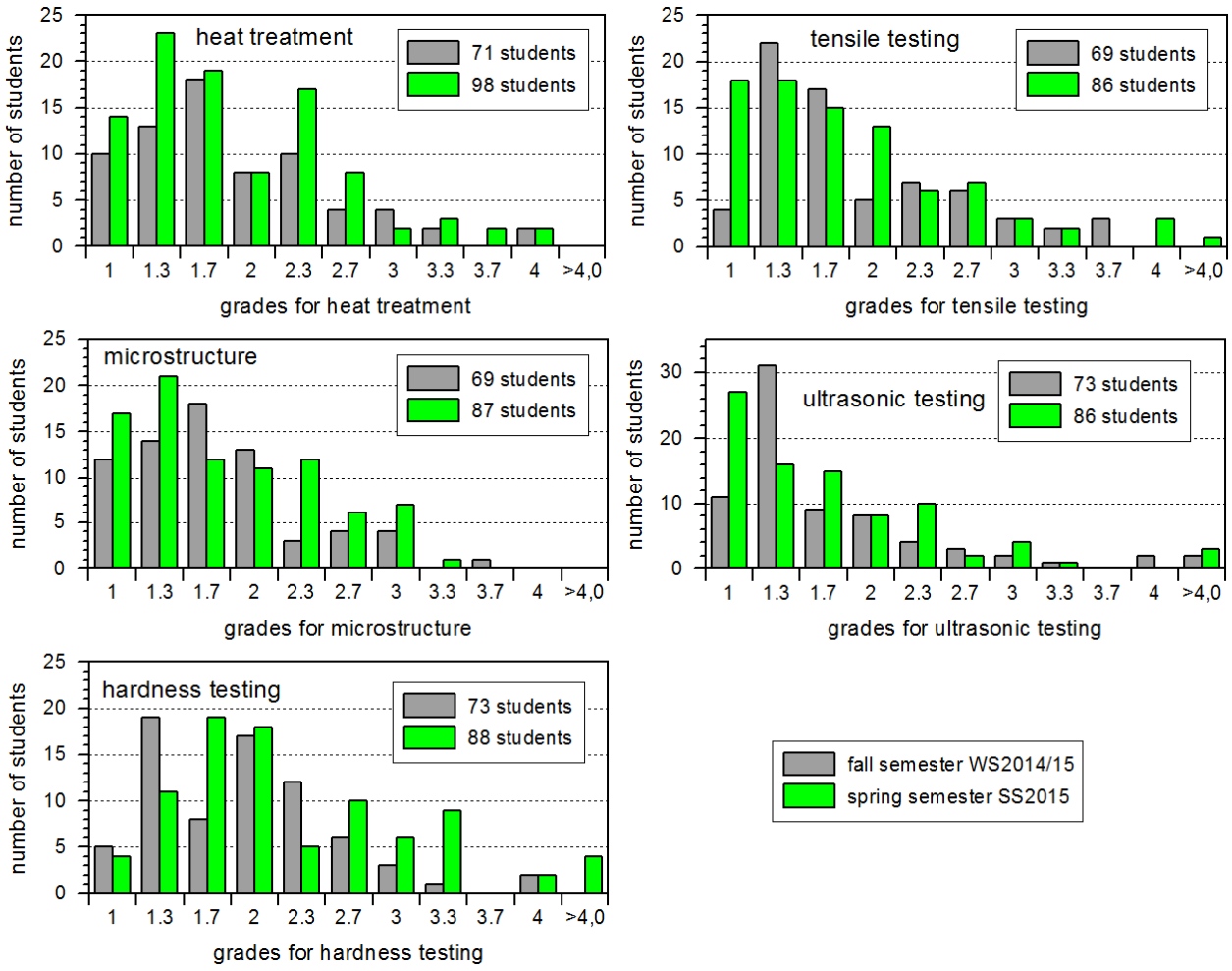

Fig. 2: Number of grades for 5 different experiments of students taking a lab course at HTW comparing fall semester 2014 without and spring semester 2015 with lecture films.

Asking the students, the overall opinion showed that the students enjoyed watching the introductory films. Although the improvement is not yet statistically significant working in the lab was more pleasurable for the lecturer in spring 2015 and students enjoyed the practical learning experience.

CONCLUSIONS AND FUTURE WORK

At HTW Berlin films were produced as guided student projects to introduce laboratory courses in an interdisciplinary concept of teaching materials science. This peer to peer approach of involving students into the implementation of teaching material was assessed as beneficial in terms of student grades, concentration and attentiveness as well as ongoing lecture procedures in the material testing laboratory. Students knew how to work the equipment and fewer mistakes occurred during the experimental procedures. They were well prepared for the questioning prior to the experiment and most of them had taken serious notes improving their learning skills. Data from the course showed enhanced download activity of learning materials after watching the introductory film. This concept will be extended to the regular material science courses as it has already been shown successful for corrosion. Next step in the nearest future will be "hybrid materials" and "hardening mechanisms".

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The paper has been reviewed.