Peer-to-Peer Lecture Films in a First Year Laboratory Material Science Course

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Abstract: Material science is believed to be one of the more complicated subjects for first year students of mechanical engineering because the scientific background is generally not taught at school or during job training. First year students of mechanical and automotive engineering at HTW Berlin are required to take 2 classes in material science with laboratory exercises accompanying the education. Still, basic knowledge upon theory is necessary to work practically during lab sessions and hand out are given to the students. Additionally lecture films show the laborato20thry 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 (peer-to-peer approach). 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. Watching the introductory films lead to more download activity and actual studying of the lectures provided to prepare the experiments and furthermore lead to slightly better testing results.

Key words: Blended learning, lecture films, material science, peer to peer.

1. Introduction

Material Science for mechanical engineering students at HTW Berlin is taught via the "design-led" teaching approach [1]-[4]. 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].

Lecture information and a wide range of teaching materials are provided in the moodle-based material science course [5]. This course basically addresses first year students in 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 enroll 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 each student is responsible for her/his 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. First results have been published at Head`16 [3] and are now updated.

2. Peer-to-Peer Approach in Film Making at HTW

Class results indicate that involving students directly into teaching activities can be very effective in getting students to engage in critical thinking [6], [7] thus, producing deeper learning outcomes [8], [9]. Well known methods are for example: "think pair share", peer instruction [10], reciprocal peer tutoring [11] or undergraduate teaching assistance [12]

Since 2014 the 3I-model (Fig. 1) has been developed within the externally funded OLP project at HTW Berlin [13]. 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 are good examples how to instruct in an effective way especially regarding the peer-to-peer aspect.

Information

Short video inputs to replace the traditional frontal type of teaching basic knowledge for inverted classroom setups [13].

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.

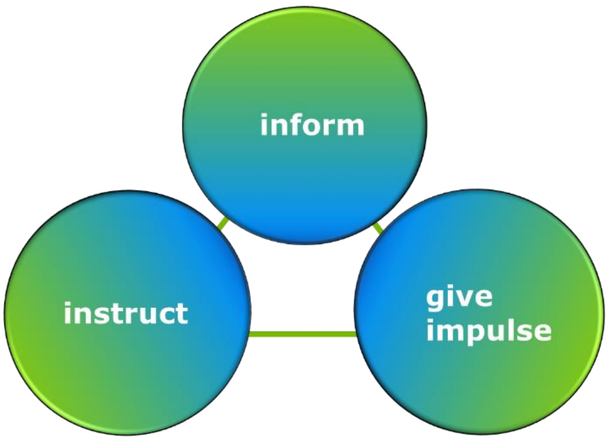

Fig. 1. 3I model overview.

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. Effective operation of the lecture films is 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 [13].

3. Exam Results

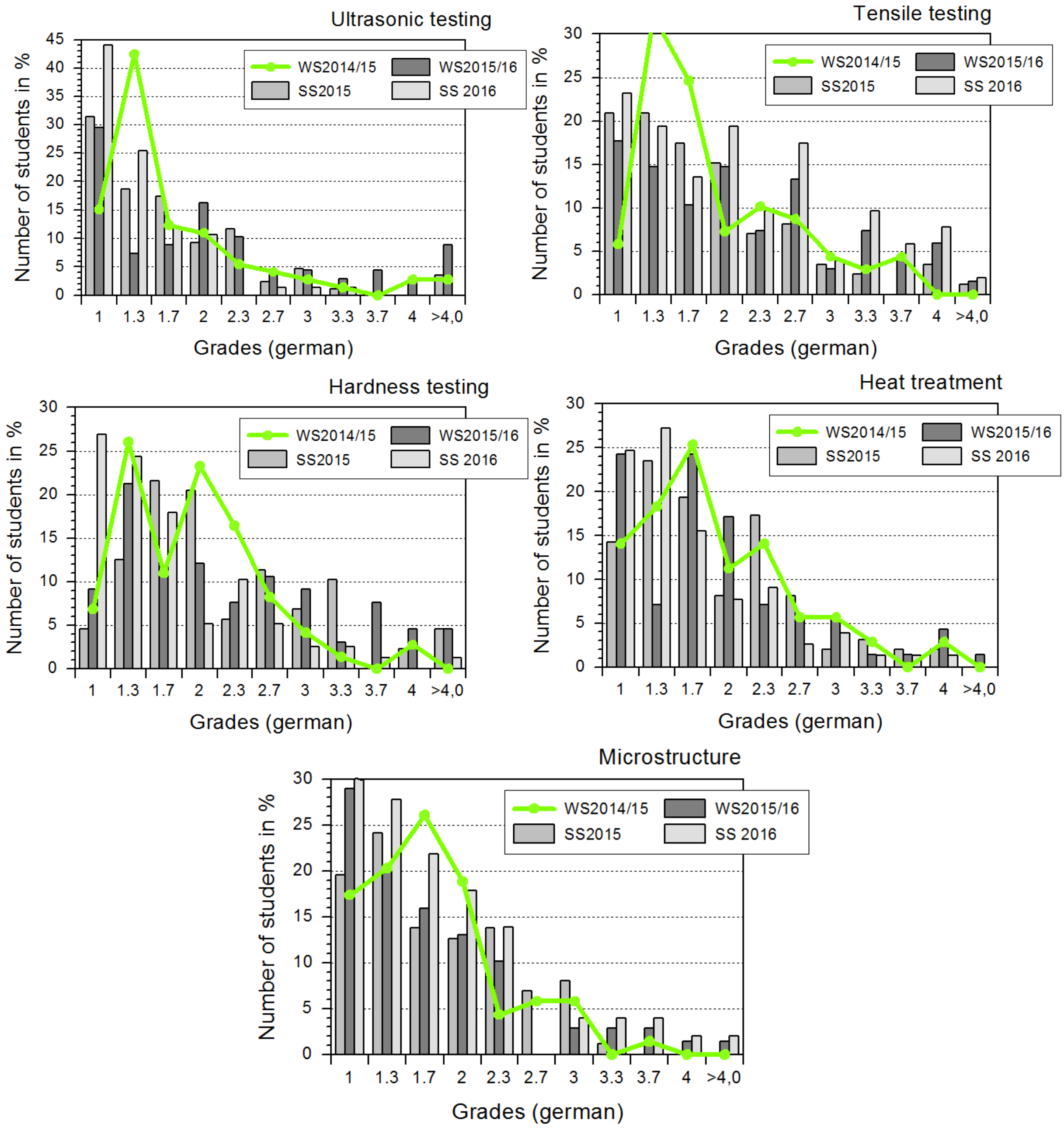

Fig. 2. Number of grades for 5 different experiments of students taking a lab course at HTW comparing fall semester 2014 without lecture films (green line) and spring semester 2015 as wells as fall semester 2015/16 and spring semester 2016 with lecture films (histogram).

This concept applied first in spring semester 2015 [4] and overall results slightly increased (grade average in WS2014/15: 1,92 (64 students) compared to SS2015: 1,87 (84 students) (Table 1). But, not all experiments were subject for better results, such as "hardening" due to the fact of being the first experiment of the semester and the films have not been taken as a serious method of preparing (Fig. 2). Lower grades in WS2015 (1,99) are due to large differences of the results obtained from mechanical engineering (1,80) and automotive engineering students (2,17), Table 1). Fall semester 2015/2016 displayed a great difference between results obtained by mechanical engineering and automotive engineering students. In SS 2016 grades were better than all previous semesters (1,85). Overall there is a slight shift towards better grades since establishing lecture films as means of self-taught learning prior to laboratory classes.

A slight shift towards better grades after watching and working with lecture films was noticeable for ultrasonic testing, heat treatment and microstructural analysis (Fig. 2).

4. Evaluation and Discussion

To introduce the laboratory experiments lecture films appeal to many students and 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 [14]-[17]. 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. 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 partly improved and the groups worked homogenously with lots of inspiration. The students asked important questions, initiated discussions, were eager to dispose their knowledge and learn more of the details and even those students, who did not attend the lecture classes increased their understanding of complicated correlations.

Not under evaluation is possible boredom during the viewing of the films. But, since the laboratory films are strictly under 5 min and actual experiments are shown, without mentioning of results of course, we do not think that a lack of interest was an issue. Moreover, once the students started to watch the films they completed it – with exception of the end titles.

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.

5. Conclusion

Lecture 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 prepared better 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 and hybrid materials. Next step will be "polymers" and "hardening mechanisms".

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References

[1] Ashby, M., Shercliff, H., & Cebon, D. (2013). *Materials Engineering, Science, Processing and Design*. ISBN-13: 978-0080994345 (3rd edition).

[2] Pfennig, A. (2015). Materials Science comes to life for engineering students, A unique teaching resource for materials. Retrieved from the website: http://www.grantadesign.com/education/reviews/

[3] Pfennig, A., & Hadwiger, P. (2016). Peer-to-peer lecture films - a successful study concept for a first year laboratory material science course. *Procedia - Social and Behavioral Sciences*, *228*, 24-31.

[4] Pfennig, A., & Hadwiger, P., (2015). Improving study skills by implementing peer to peer lecture films, “e-Learning'15”. HTWBerlin, Germany.

[5] Qualitätspakt Lehre – Teil-Projekt „excelLuS. Teilprojekt HTW Berlin: BMBF Förderkennzeichen: 01 PL 11034, Förderzeitraum vom 01.11.2011 - 30.06.2016.

[6] Colorado State Universtiy. (2015). Using peer teaching in the classroom. Retrieved from the website: http://teaching.colostate.edu/tips/tip.cfm?tipid=180

[7] Lord, T., (2012). 101 reasons for using cooperative learning in biology teaching. *The American Biology Teacher*, *63(1)*, 30-38.

[8] Cuseo, J. B. (1992). Tips for students when forming learning teams: How to collaborate with peers to improve your academic performance. *Cooperative Learning and College Teaching*, *7(3)*, 11-16.

[9] Goto, K., & Schneider, J. (2010). Learning through teaching: Challenges and opportunities in facilitating student learning in food science and nutrition by using the interteaching approach. *Journal of Food Science Education*, *9(1)*, 31-35.

[10] Whitman, N. A., & Fife, J. D. (1988). Peer teaching: To teach is to learn twice. ASHE-ERIC Higher Education Report No. 4.

[11] Simon, B., Kohanfars, M., Lee, J., Tamayo, K., & Cutts, Q. (2010). Experience report: Peer instruction in introductory computing. *41st ACM Technical Symposium on Computer Science Education*, 341-345.

[12] Fingerson, L., & Culley, A. (2001). Collaborators in teaching and learning: Undergraduate teaching assistants in the classroom. *Teaching Sociology*, *29(3)*, 299-315.

[13] OLP Online Lehre Plus / external fund: Berliner Qualitätsoffensive für die Lehre. Retrieved from the website: https://www.berlin.de/sen/wissenschaft/wissenschaftspolitik/finanzierung/vereinbarung_berliner_qualitaetsoffensive_fur_die_lehre_2012_bis_2016.pdf

[14] Berrett, D. (2012). How ‘flipping’ the classroom can improve the traditional lecture. *The Chronicle of Higher Education*. Retrieved from the website: http://chronicle.com/article/How-Flipping-the-Classroom/130857/

[15] Brame, C. J. (2015). Flipping the classroom. Retrieved from the website: http://cft.vanderbilt.edu/files/Flipping-the-classroom.pdf

[16] Fischer, M., & Spannagel, C. (2012). Lernen mit vorlesungsvideos in der umgedrehten mathematikvorlesung. *DELFI*, 225-236.

[17] Braun, I., *et al*. (2012). Inverted classroom an der hochschule karlsruhe - ein nicht quantisierter flip, Beitrag zu „Das Inverted Classroom Model: Begleitband zur ersten deutschen ICM-Konferenz“, Jürgen Handke, Alexander Sperl (Hrsg.), Oldenbourg Verlag.

Anja Pfennig was born in Büdelsdorf, Germany in 1970. She studied minerology at the University Bonn, Germany, where she graduated in 1997. Her Ph. D. was in the field of ceramic moulds for liquid metal casting was earned in 2001 from the University of Erlangen, Germany. She then worked for siemens energy in charge of ceramic shields and transferred to Berlin in 2008 where she currently teaches material science at the Applied University Berlin, HTW. A. Pfennig research expertise is corrosion fatigue. Her interest in teaching is new teaching methods and e-learning to enhance learning output and cope in future positions.