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Fostering Participation and Transparency in Laboratory Higher Education - Experiences with the "Seminar Blog"

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Abstract
In laboratory higher education critical evaluation and assessment of obtained data and the implemented measurement procedures are addressed. Typically, to foster this reflection process laboratory reports are requested. Such written assignments are usually carried out individually or by reduced groups of students, therefore more focused on the individual evaluation of one's own experimental experience, than on sharing the results of such evaluation with other students.
Sharing results and expectations for a given experiment in a transparent way with one another may help identifying sources of error more easily. But above all it may help sharing their knowledge and the insight they gained from the experiments, thereby facilitating the achievement of a more complete assessment and set of conclusions obtained. To foster such a participation process the Introductory Laboratory of the Postgraduate Program Renewable Energy and the European Master in Renewable Energy at the University of Oldenburg which usually consisted of theoretical lectures, laboratory days and evaluation sessions was extended in autumn 2015 by a "Seminar Blog" a WordPress based collective e-portfolio concept, which makes it possible to depict rising questions, steps and results of a research process. Collective-shared representations function as a gateway for discussions and feedback-activities. The dynamically mapping and representation of the research and learning process open ways of prompt and 'timely' communication about questions and uncertainties. In this paper results from the implementation of the "Seminar Blog" as an online tool for enabling the direct and transparent share of experimental results are discussed.

1. Introduction
Laboratory activities, if planed accordingly, can offer a very favourable environment for promoting scientific literacy in natural sciences higher education: they can be oriented to the formulation of student's own hypothesis and expectations, to the sound formulation of scientific explanations and their critical revision as well as even to the development of self-directed experimental work from the students. For achieving these aims inquiry-based laboratory concepts are required [1].
In such laboratory concepts the students work is not be merely reduced to the experimental work. Instead, critical evaluation and assessment of the obtained data and, thereby, on the implemented measurement procedures as well as the development of own hypothesis and research questions within the context of the given experiment represents a very relevant part of the learning process in inquiry-based laboratory courses [2].
Typically, to foster the above mentioned reflection process laboratory reports and protocols are requested so that a deeper understanding and assessment of the obtained data and experimental activities is performed. Such written assignments are usually carried out individually or by reduced groups of students. Being often long and comprehensive, they are more focused on the individual evaluation of one's own experimental experience, than on sharing the results of such evaluation with other students.
But often enough results from a particular experiment are very similar for different students groups, and so are measurement errors and mistakes in their measurement procedures. Sharing results and expectations for a given experiment in a transparent way with one another may help identifying sources of error more easily. But above all it may help sharing their knowledge and the insight they gained from the experiments, thereby facilitating the achievement of a more complete assessment and set of conclusions obtained.
To foster this collaborative learning process in an introductory laboratory course conducted in October 2015 a web based Blog Tool (the Seminar Blog) was introduced. In this paper results from that experience are presented and main conclusions are withdrawn.

2. Our application context: the Intro Lab at the PPRE-Programme

The so called “Intro Lab” is the first laboratory experience with which students from the Postgraduate Programme Renewable Energy (PPRE; www.ppre.de) and European Master of Renewable Energy (EUREC; https://www.uni-oldenburg.de/en/eurec/) at the University of Oldenburg are confronted. The laboratory course is planned as a two week full time activity devoted to investigate basic concepts of electrical power systems as well as meteorological sensors for renewable energy applications. But beyond the subject-specific and physical cognitive knowledge, one of its main learning objectives is to address experimental inaccuracies, measurement errors and experimental ways to deal with these. Therefore, students are asked on ways to improve the given set-ups or to assess the appropriateness of different experimental approaches, getting actively involved in their own construction of scientific knowledge.

Typically, experiments are carried out in groups of two students on one day and the following day evaluation sessions take place where experimental results obtained by the students are discussed with the whole group. In 2015 these evaluation sessions were enhanced by using the Seminar Blog where students publish their results before the evaluation session. Being the Intro Lab quite tight and intensive in the schedule, students do not have much time to get familiar with additional learning platforms. A daily workload of 1.5 hours per student was assumed to be invested on checking the Blog or uploading information there. Thus, the implementation of the Seminar Blog posed a relevant particular challenge: the blog needed to be very well structured and easy to handle in all its functions in order to avoid high reluctance to use it due to student's frustration.

3. The Seminar Blog

The Seminar Blog can be considered as an web 2.0 based e-learning tool which faces the challanges of Higher Education within the digital age: In the course of an increasing digitalisation of science during the last years (e.g. Big Data, Science Blogs, the Open Access-Movement, Open Educational Ressources etc.), science in the digital age turns more and more into e-Science – an increasingly digital supported science. Crucial for the establishment of e-Science are the interactive possiblities of the so-called web 2.0. The notion web 2.0 emphasises the importance/potentials of dialogical interaction wihin the internet. UGC-technology (User Generated Content) permits the user to produce internet content and shape their space within the internet in the course of interaction processes. This interaction possibilties evoke in the scientific field phenomena like Wikis, Blogs and e-Lectures. Higher Education has to face the challenge of this media change within the scientific field [3]. According to principles of inquiry based learning web 2.0-based e-tools should be used, to support the – interactive/dialogically – aspects of students research process. For this purpose the so-called Seminar Blog has been developed [4] The Seminar Blog mostly serves as an e-portfolio and can be considered as a didactical and process-oriented tool for reflections which enables a dynamically mapping and representation of the research and learning process.

As a collective shared tool the Seminar Blog provides spaces for an ongoing digitally-based, collaborative communication among learners. Mostly the learners are asked to give and to get feedback from each other. These feedback-circles can be considered as a strategy which supports the search for convincing arguments and growing evidence within the students research process: Within learning groups, a common understanding of inquiry-based learning content can be achieved (collective knowledge production). Intersubjective valid meaning is produced within a dialogical process which thematizes an appropriate understanding of data and facts. Within this process individual knowledge and individual perspectives are shared and discussed (distributed knowledge). Within the Intro Lab the Seminar Blog mainly has been used to share and discuss the experimental approach and results of experiments.

4. Results

Figure 1 shows a screen-shot of the Seminar Blog created for and used during the Intro Lab. Each of the experiments was placed on a separate page where one or several groups of students could upload their own experimental results and conclusions. All participants were free to pose questions, comment, constructively criticise or give positive feedback on the information uploaded by the others.

Fig. 1. Screenshot of the Seminar Blog implemented for use during the Intro Lab

For assessing the suitability of the implemented Seminar Blog Tool in pursuing our goals of fostering sound discussions and transparency on the experimental procedure followed and the results obtained from a given set-up a questionnaire-based evaluation was carried out. Out of 32 participants, 21 fully answered the questionnaire. The general evaluation of the Seminar blog was very positive, with 80,95 % of participants stating that the seminar blog was well structured (answers “I fully agree” and “I agree”) or 95,24 % stating that it was useful to clearly see the results and procedure followed by other student's groups.

Figure 2 shows the responses to the three main questions in the questionnaire devoted to the suitability of the Seminar Blog to foster sound discussions based on the transparent share of the experimental results among the participants. It can be clearly seen that more than three fourths of the students agree that the Blog was a useful tool for fostering discussion, or to obtain new ideas for improving one's own experimental procedure.

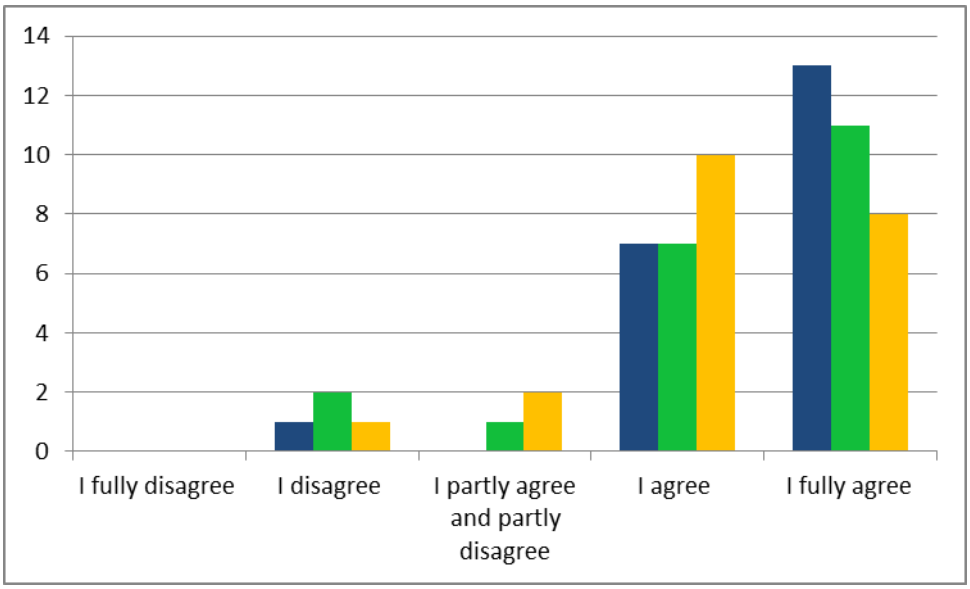

Fig 2 - Results from following 3 questions: Seeing the results from other groups and the discussion was helpful for rethinking and reflecting on my own results (blue) The blog was useful for fostering sound discussion on the experimental results (green); From the results and discussions in the blog

(and in the evaluation sessions) I got new ideas for improving my own experimental procedure (yellow).

Figure 3 shows the answers to the only two questions contained in the survey about their attitude towards a possible further implementation of the Seminar Blog in other Laboratory courses of the PPRE and EUREC masters programs. A strong positive feedback was obtained from the students in this regard. This underlines their positive evaluation of their learning experience with the Seminar Blog.

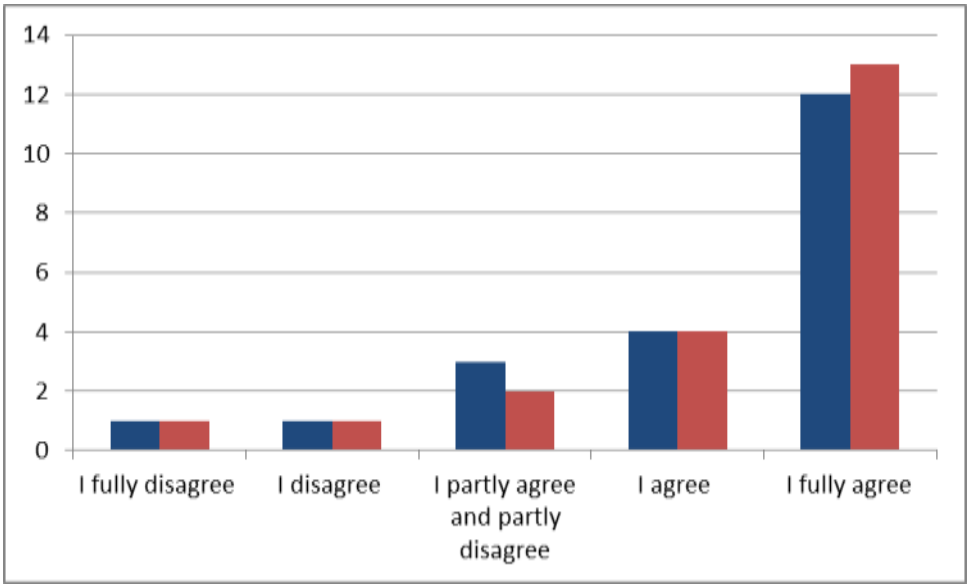

Fig. 3 Results from following 2 questions: I would like to make use of a similar blog for sharing the results of the Winter Lab (blue). I find using a similar blog in the Winter Lab would be useful for developing deeper insights in the lab experiments based on other group's experiences (red).

5. Conclusions and outlook

The Seminar Blog has proven to be a very promising and suitable tool for promoting a more transparent discussion on experimental laboratory work in physics higher education. It is a relatively easy to use tool which allows students to rethink and reflect more critically on their own experimental results by comparing them with those from other colleagues. By enabling a structured and transparent discussion process it makes a more collaborative assessment of experimental results possible, leading thereby to deeper insight in the investigated phenomena and to a more complete set of conclusions from a given experiment.

All these processes take time, especially in such an asynchronous scheme where the discussion might be spread over a certain period of time. During the Intro Lab with its intense schedule and the duration of only two weeks the described advantages of implementing the Seminar Blog can only be partly realised.

Nevertheless the results from the evaluation are quite encouraging for enhancing the application of the Seminar Blog in other laboratory courses. Having two weeks for preparation, performance of the laboratory and evaluation different student groups can perform several feedback cycles on the Seminar Blog. Results, expectations and hypothesis from one group of students working with a given experimental set-up can be transparently made available for the following group of students through the Seminar Blog. This would enable the second group to work with the previous hypothesis and results and develop them further. In such contexts the Seminar Blog could be a powerful tool for promoting the collaborative research or inquiry-based work on a given experimental set up among the students.

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