

# USING PRE-LECTURE ASSIGNMENTS TO ENHANCE STUDENTS LEARNING IN INTRODUCTORY PHYSICS

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## ABSTRACT

The prior knowledge of a student is always the inception to his/her learning. Recognizing and increasing students' prior knowledge advances both student and teacher to construct better learning processes, no matter what kind of teaching methods are used. Recognition helps in both cases, traditional lecturing and active engagement methods. In the teacher point of view recognizing students' prior knowledge helps teacher to plan teaching and methods suitable for students. In students' point of view recognizing prior knowledge prepares to the face-to-face sessions of any kind. In Tampere UAS, introductory physics teaching is strongly going towards active engagement of the students. The activation is extended also outside lectures, in which the pre-lecture assignments play a role. The nature of pre-lecture assignments varies from conceptual questions to calculatory problems, some of which are equipped with solution videos. The main objectives are to recognize and increase students' prior knowledge, to activate students between lectures, to use lecture time more efficiently and actively and to be able to concentrate on more demanding aspects of the topic during lectures. Pre-lecture assignments are not a part of course assessment, but strongly help students to prepare to week exams and final exam. As the pre-lecture assignments are not a part of course assessment, students are supposed to voluntarily report the number of completed assignments in the shared document, from which they can monitor their own and other students activity. Based on data gathered from students:

- Prior knowledge of the topic in question is recalled to active memory.
- Students are able to recognize totally new concepts on subject matter.
- Students are able to recognize physical phenomena and laws concerning the subject matter.
- More effort is needed to activate students to do pre-lecture assignments.

**Keywords:** Active learning; Pre-lecture assignments; Prior knowledge.

## SUMMARY

Active learning methods are the key to better learning outcomes. Using pre-lecture assignments students can be activated before and between lectures and teacher can focus on more demanding aspects of the topic during lectures. However, students easily think that they should get some extra points or pre-lecture assignments should be more or less compulsory so that they find motivation to do them. In this case study we present feedback from students and discuss how to activate students more.

## INTRODUCTION

Tampere UAS has strongly developed introductory engineering education towards active engagement methods (Suhonen, S., Tiili, J., 2014). As a part of the development process, the pre-lecture assignments are used for several purposes to support the active engagement learning environment. The use of pre-lecture assignments was piloted in the first year engineering physics course “Electricity and Magnetism” in spring 2014. This paper describes one way of using pre-lecture assignments and how students react to assignments. In the end of the course students were asked by a few questions how often they did the given tasks and did they find them useful.

## ACTIVATING STUDENTS PRIOR TO THE LECTURES

Activating learning environment is reported to be the key solution to achieve better learning outcomes. Students studying in active learning environment have been reported to achieve better learning outcomes compared to students studying in traditional lecture classes (Hake, R., 1998). The active learning methods, for example Peer Instruction (Crouch, C. H., Mazur, E., 2001) and interactive lecture demonstrations (Sokoloff, D.R., Thornton, R.K., 1997) require that students prepare themselves to the lectures beforehand. This preparation may be taken care with textbook reading assignments, tutorial video clips (Callens, R. *et al.*, 2011), online pre-lectures (Sadaghiani, H., 2012) or other pre-lecture assignments. Pre-lecture assignments are also useful in traditional lecturing (Kolari, S., Savander-Ranne, C., 2007). It is always an advantage if students are prepared to the subjects concerned beforehand.

In order to improve the learning outcomes of the engineering students’ introductory physics courses, the new method to study introductory physics in engineering education was reported in SEFI2013 conference (Tiili, J., Suhonen, S., 2013). The key points in the new method to study physics in Tampere UAS are active engagement during lectures, the use of week exams to emphasize continuous assessment

and to use solution videos to homework problems in order to release time for week exams and active engagement in the lectures. The students' active role is wanted to extend outside lectures, so students are encouraged to study beforehand using pre-lecture assignments. The main objectives of the pre-lecture assignments are:

- To increase students' prior knowledge;
- To perceive students' preconceptions;
- To concentrate on more demanding aspects of a topic;
- To concentrate more on examples concerning students' own field of study during lectures;
- To use lecturing time more efficiently;
- To motivate a student to spent more time on studying.

In the course of "Electricity and Magnetism", pre-lecture assignments were given to students one week before lectures. The assignments included both conceptual and calculus-based problems. Students carried out the assignments and registered their accomplishments to a shared spreadsheet document in an e-learning platform Moodle. The model solutions to calculus-based questions were distributed using links to YouTube videos. The assignments themselves were not a part of the course assessment. An example of one week's pre-lecture assignment is stated below:

*Topic for the next week is electric potential and voltage, book's chapter 1.4. Find out (e.g. in groups) the meaning of electric potential, voltage, the work done by electric field and how to calculate the potential of a point charge (see example 1.17). Calculate exercises 1.29, 1.37 and 1.38. Video solutions are also available if you need extra help.*

The whole class was divided to six groups, six students in each group. The students were encouraged to work in groups also outside the classroom. For this purpose one classroom was reserved one hour per week for the whole duration of the course. On the basis of discussion with students, they also worked in groups, at least before the week exams.

## RESULTS

In the end of the course students were asked by a questionnaire how well different methods work in practice and how to improve the teaching methods used. 27 of 36 students gave their feedback. Questions about pre-lecture assignments were:

- How often did you do pre-lecture assignments?
- How much did the pre-lecture assignments activate you to study?
- Assistance of the pre-lecture assignments to the learning outcomes?
- What was the usefulness of the pre-lecture assignments if you did them? If you didn't do them, how can you be activated?

The results for the first question are shown in figure 1.

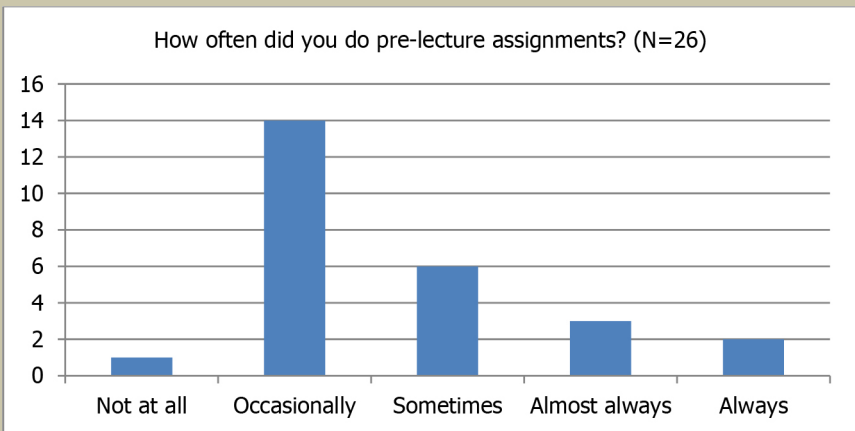


Fig. 1. Activity of completing the pre-lecture assignments. Total number of answers is 26.

Students' activity of doing pre-lecture assignments was not as active as wanted. Most of the students did them only occasionally. However, they realize the usefulness of pre-lecture assignments for their learning but motivation was still rather low. Here are some examples of students' feedback:

*"I learned a lot. I was better prepared for the lectures because I had a small vision of the topic."*

*"It's much easier to follow lectures when I was oriented for the topic beforehand."*

*"I would have done the pre-lecture assignments if I was forced to. Secondly, I was already familiar with the subject."*

*"I didn't do any assignments. I'd be motivated if part of the assignments were obligatory and I got some extra points."*

The second question was associated to the same aspect, do the pre-lecture assignments activate students prior the lectures. Figure 2 summarises the student feedback. According to answers the activation could be increased if students get some benefit for the final course assessment. *"If I get some extra points!"* Most of the students are oriented to collect points for final assessment and they maybe do not realize the worth of studying before lectures. Students were told that week exams might include even same problems. For some reason this was not motivating enough. On the other hand, this is also a question of assessment; you get what you assess. When the final grade is based on accumulation of points from week and final exams, it guides student a lot. Some other evaluation methods must be brought into use in addition to exams.

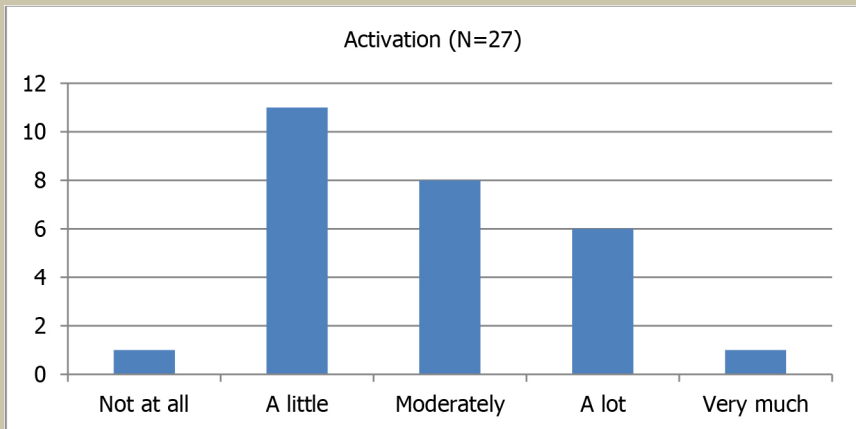


Fig. 2. Students' feedback for activating effect of the pre-lecture assignments. Total number of answers is 27.

As a third question students were asked, whether the pre-lecture assignments helped them to achieve the learning objectives and improved their learning outcomes. Figure 3 summarizes the results.

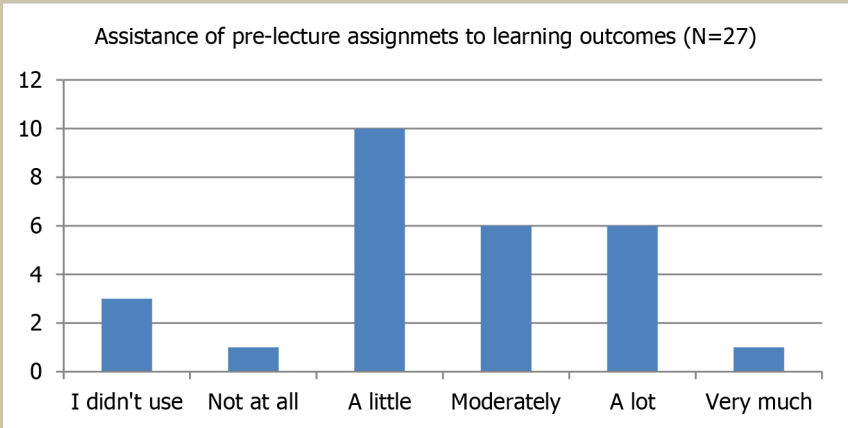


Fig. 3. Assistance of assignments. Total number of answers is 26.

Students who had made at least a few pre-lecture assignments find them useful. Their knowledge increased at least a bit, they were able to recognize physical phenomena and laws concerning the subject matter.

*"I had no previous knowledge of the course topics so it was useful to be somehow prepared for lectures."*

*"Pre-lecture assignments are a good way to get students to study."*

*"Pre-lecture assignments improved my skills for calculating exercises."*

*"It was easy to find the more important subjects."*

## CONCLUSIONS

Students do realize that pre-lecture assignments are good way to prepare themselves for lectures and increase knowledge before lectures. They can recognize totally new concepts on the subject matter. Benefits are clear. However their activation for doing the assignments was not as high level as wanted. For the next course some of the assignments might be compulsory and preliminary work could be discussed in groups in the beginning of the lectures. Hence the teacher can also give feedback to students. Some of the assignments could also be reviewed by returning the completed assignments to the e-learning platform. Checking each students' or groups' assignments needs of course time and effort. A peer evaluation of pre-lecture assignments between student groups could be an interesting solution. Anyway,

pre-lecture assignments will be taken in active use for most of the courses in the future in Tampere UAS.

Based on instructor's experience from previous years, pass rate of the course was observed to be higher than on average. However, there is usually rather large variation between student groups and therefore it cannot be assigned to pre-lecture assignments alone.

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