

Short guide for instructors of problem sessions for physics students

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Based on course material "Goed Werkcollege geven", DidO, Faculteit WTM, TU Delft (1997).

Some facts from research and common sense

Problem sessions: The students should work 90% of the time - no demonstrations!

Most learning/teaching methods are very inefficient, except one: Students that actively try to solve problems themselves, combined with self-study where needed. Research shows, that when the instructor demonstrates on the blackboard how a problem should be solved, the students remember very little one week later. They remember a lot after actively trying themselves. So, the goal is to have the students working themselves for 90% of the time during the problem sessions. The instructors are only present to shortly help out when a student gets stuck or confused.

The instructor has no time to explain contents! Only put/keep them on the right path.

One class hour is 45 minutes, a group typically has 20 students. So, you have about 2 minutes for helping per student per class hour. This is very little time! So, we need to work very efficient and spend little time per student. Use these methods:

- 1) Rather than teaching contents (which is often what we like to do, and which is interesting and fun), focus on getting the students back to doing useful study work themselves as quick as possible. For most questions on contents, refer to the book for self study.
- 2) When they have a question on how to get further with a problem, focus on getting them back to work on the right path with minimal input. Often, they can discover themselves why they are stuck and proceed after asking them a question about the part that is in error. After that there is no need to stick around to see how it works out.
- 3) Stimulate that students work together and help/teach each other. Refer one student to another if you see that it makes a good match for getting together to the good result.

Spend time on motivated students, not on compensating lack of work by lazy students.

Typically, you have two types of students in the class:

- 1) Students that prepared the class, did some homework or reading.
- 2) Students that come totally unprepared.

The group 1) deserves most of your time and attention, but group 2) will ask more of your time. Make sure this does not happen, *do not reward coming to class unprepared*. That is, spend little time on students that come unprepared. Instead, put this group to work, by indicating what problem to start on, and putting them to self-study in the book. Then, spend most of the time following up on students that did prepare the class.

Planning amount of work for exam/homework/problem session.

A rough guideline is that the students will carry out the work 2 to 3 times slower than the instructors.

Silence.

The hardest part of teaching is being silent. Wait long enough after asking a question, listen, get the students to be active instead of you, give feedback.

Good method for running a problem session

At the beginning of the two/three class hours session, use 2-5 minutes (not more!) for addressing the group as a whole on these issues:

- what is the central concept in this session, repeat/summary from the lectures.
- what is the list of problems that the group will work on today.
- stimulate the group, why are these problems fun, explain that they can handle them.

At the end, use again 2-5 minutes (not more!) for:

- summarizing the main concepts again, and the main insight/obstacle that showed up in problems.
- announcing the homework for the next session.

In between, the students should work on the problems by themselves, while the instructor makes rounds to check progress and to shortly help where needed. It is optimal to make rounds of about 10 minutes

Very rarely, insert short sessions (few minutes or less) for addressing the entire group. Only do this when this is clearly efficient. For example when everyone makes the same mistake, because the book is not clear, it is a good idea to quickly explain this in a short lecture for the whole group.

Systematic approach to problem solving

You need to teach the students in fact two things;

- 1) Approach: How to solve problems with a systematic method.
- 2) Contents: How to solve problems that use the contents and concepts of the specific course.

One could argue that it is not our task to do 1), but doing so has many advantages:

- It is easier to help the students in little time if their writings are logically organized
- If most students do it, correcting exams takes much less time
- If most students do it, you can do 2) at a higher level.

A systematic approach involves three phases:

- 1) Analyze the problem: What do they actually ask? What other information is relevant and mentioned. **Make a sketch.** Are there hints mentioned? List the relevant symbols and formula's, theory.
- 2) Start solving the problem. Outline the approach first. Work out the algebra in symbols – not in numbers.
- 3) Evaluate the outcome. Does the answer make sense, is the sign right? Finding that the mass of the electron is -25 kg, should cause some alarm and start some feedback.

Working method for efficient supervision of problem sessions

