Learning University Physics in Projects and Lectures

Focus Group Discussions in Didactics: Student Opinions and Perceptions

Joakim Cederkall[1)]

Abstract— **The result of a focus group study with second year physics students is reported. The aim has been to investigate student perceptions of teaching and learning in project form. Specifically, the question is if project work can combine the learning of skills, in this case knowledge of numerical algorithms and computer programming, with a deeper understanding of a specific physics problem and if such a combined learning activity can help to remedy student stress by providing a broader learning context. The conclusion, drawn from an analysis of transcripts and recorded data, is that students appreciate project work for the more informal exchange that takes place with teachers and among students. However, in many cases little improvement is seen in work planning as a tendency to delay report writing to close to the dead line remains. Project work in itself can therefore not be seen as a general solution to reduce student stress although the activity is appreciated for other reasons.**

I. Introduction

Often in discussions about teaching and learning in physics and mathematics it is said that teachers should focus on practical matters that students find useful and which tell them something about their everyday world in comparison to purely theoretical treatises. It is likewise often said that teachers should focus on deep learning, understanding and reflection, and that surface learning should be avoided. However, to be able to use a new method for practical purposes after a course, students also need to develop some level of proficiency in addition to understanding the underlying reasoning. So, by only following a paradigm of deep learning, a course may risk to spend extensive amounts of time on many discussions of conceptual matters while leaving little time for students to practise in order to obtain proficiency. Also, by focussing on everyday phenomena one is at risk of introducing too complicated effects, that cannot be treated by the students, or one oversimplifies the problem to make it tractable. In these cases one may risk that the understanding of the phenomenon in question may either lack depth, due to oversimplification, or it may look so simple that it does not inspire any reflection. Consequently, it is a well-known challenge to develop teaching and learning activities that satisfy the requirements above. This is particularly so when proficiency is needed in one subject, e.g. mathematics, in order to develop understanding in another such as physics. This is the situation for the course activity under study here.

[1)] Physics Department, Lund University, phone 046-222-7685; e-mail: joakim.cederkall@ nuclear.lu.se.

II. The Course

In order to address the challenges mentioned above the course discussed in the following tries to combine mathematics, programming and physics under one umbrella. It includes a segment in mathematics, one in statistical and quantum mechanics and one in computational physics. As part of the course the students work with projects that try to relate these topics to each other. The project studied in this report belongs to the computational physics segment and has its application in mechanics. The students that participate in the course are second year physics students. They study the computational physics segment in parallel with segments in mathematics and quantum mechanics. The number of students that attend is typically 40-50 in the fall and around 15 in the spring semester.

The segment has an introductory part consisting of six three hour sessions and a week long project. Currently one three hour session gives an introduction to programming concepts with code demonstrations done with computer and projector. This is followed by exercises in the computer laboratory during the first week. The second week has lectures and demonstrations in basic numerical methods and related exercises. Finally, the last part of the introduction has lectures and exercises in numerical methods for differential equations.

After the introduction the students are presented with two project problems. The first problem deals with solving the equation of motion for a ball thrown in air and the second deals with solving the equations of motion for planets around the Sun. The idea is to introduce the students to a problem they know the basic mathematics of from calculus, and are familiar with from introductory mechanics, but which is not solvable without computer. The students report their findings individually in a written report and by electronically submitting their computer codes. The problems are divided into sub-questions that give a stated number of points. All in all the segment takes four weeks. The students have two extra weeks to finalize their programs and write the report. During this period the teachers are also available for advice.

III. The Study

A. The Aim of the Study

As indicated above the purpose of the study was to see to if students find project work and report writing to be a better way to teach physics compared to other teaching/learning methods particularly when it comes to student experienced stress.

B. Focus Groups

The method used for the study was discussions in focus groups [1]. The reason this method was selected is its potential to create a spontaneous and relaxed exchange of opinons between participants. One main challenge with focus group discussions as a method is to find and motivate a relevant group of persons to participate. This was a challenge also for this study. Two groups were finally formed by using two students as contact persons. The first group consisted of three men and two women and the second group of two women and one man. One of the persons that had agreed to participate in the latter group opted out in the last minute.

C. Topics covered in the discussions

As preparation for the discussions a set of general topics were worked out in an introductory discussion with two students that assisted in the study. The emphasis was to investigate if the students experienced more collaboration in a project based course compared to a lecture based one and if this would influence the amount of time spent studying. Of specific interest was also to see if informal collaboration led to a feeling of relevance which could be translated into an experience of less stress. One inspiration for investigating this question comes from time management studies [2]. It can e.g. be speculated that students that experience a higher level of relevance, e.g. given by collaboration with peers, would feel less stress and therefore show higher peformance.

D. Procedure

Two discussion sessions were organized with some weeks interval. The first discussion was transcribed by two persons, a PhD student and an undergraduate student. These persons did not participate in the discussion. The author acted as moderator while the five students discussed freely around the topics mentioned above. The duration was 1h 30 mins. The second discussion followed the same lines and was recorded as well as transcribed. In this case the moderator made the transcription and operated a dictaphone. The discussion had three participants and lasted 1h 45 mins.

The data from the two discussions were analysed in two steps. In the first step the transcriptions were shortened and conclusions drawn from each discussion separetely using the discussion points worked out beforehand. In the second step the two discussions were compared and contrasted against each other in order to find points that seemed important to both groups.

IV. Result

The outcome of the analysis using some of the topics that came up in the discussions is given in the following.

A. Collaboration/Competition

There were two distinct opinions favoured. The first one favoured individual work intensively, even if project work as such was considered good, it was not necessarily perceived to be a way to practise collaboration. The second opinion favoured discussion in groups. So, it seemed persons with these two distinct opinions still found opportunities to work in their own preferred way using projects. It also appears that collaboration between 2-3 persons is most common. So, in this case informal collaboration tended to involve the same number of persons as obligatory laboratories with the difference that labs/projects were said to invite to discussions with more persons than one worked with regularly. There was a general opinion in the two groups that helping each other was more productive than competing. One participant admitted that shining i.e. being the best or being better at a task, and to teach other students, boasts self-confidence and consequently can be a force when learning new things.

B. Time Spent Studying

Only one student in the first group wanted to quantify the amount of time spent studying. In this case 30 h was mentioned. One person said she worked harder on a project oriented course than otherwise. In the second group one of the students said he spends 16 hours per day. The other two spent 20 h and 35 h per week, respectively.

C. Stress Profile

It was concluded that stress related to written exams mainly comes from the feeling of uncertainty about which questions will be given and less so from the time available at exams. The stress for the deadline for a lab or project report was perceived to be significant but a positive aspect of a project was that the students know what needs to be done. However, there was no proof that a project makes the students plan their work better i.e. that they distribute their work load of a longer period. Perhaps surprisingly, some stress relief was related to the common opinon among the students that one can often miss project deadlines without too dire consequences.

D. Perceived Relevance

Two students expressed a positive view to labs in general but there was no consensus that learning by project in itself is generally better than other methods. The project needs, just as a lab or lecture, to be well designed. The content and its presentation within the chosen activity was perceived as more important than the form itself by these students.

V. Conclusion

The relevance the students of this study felt a course has was influenced only in a limited way by the teaching/learning activity used. The time the students spent on their studies in general was less than 40 h per week, and was said to be independent of teaching/learning method. The content of the course and the planning of the activities were emphasized more than the form. Stress from a report deadline was often experienced to be as severe as that of a written exam but seemed to lead to tendencies to procrastinate. However, projects were found to provide more freedom. A better knowledge of what was required did also relieve some stress before the deadline started to approach. Finally, projects were found equally attractive by those that favoured an individual learning style as by those that favoured learning in groups.

References

[1] V. Wibeck, *Fokusgrupper. Om fokuserade gruppintervjuer som undersökningsmetod*. Studentlitteratur, 2000 and references therein.

[2] T. H. Macan et al. *College students' time management: Correlations with academic performance and stress*. Journal of Educational Psychology 1990, Vol. 82. No. 4, 760-768.