

Student Adjustable Learning Objectives that Trigger Motivation for Deep Learning

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ABSTRACT: The implementation of a project course targeting students in an international master's program is presented. The course is compulsory in the 2-years master curriculum "Embedded Electronics Engineering" at Lund University. Participants of this course are very heterogeneous in terms of specialization during their Bachelor's, study habits, as well as cultural diversity. The course is implemented by offering the students the possibility to adjust their own learning objectives, realized by offering projects with different difficulty levels. This gives the students a confidence of making a decision on their interest or capability, which creates a positive conception and possibly enhances motivation. The projects are often related to a research topic of one of the supervising PhD students, and thus, different in terms of application areas and difficulty levels. The setup of the projects gives the students the possibility to adjust their learning objectives during the duration of the course. This can be achieved by including more or less requirements during the project duration, which increases the individual motivation and in turn affects the final grade. The projects are conducted in pairs, and progress and intermediate results are discussed during several in-class oral presentations. Assessment is based on the project results and a written report.

1 INTRODUCTION

Deep learning is unquestionably the most efficient strategy that should be targeted in any classroom, regardless of the education level, i.e., elementary school to university. In accordance to Blooms revised taxonomy do *remembering*, *understanding*, and *applying* belong to the lower classification levels, and are thus less desirable, see Figure 1 [1]. High-order and deep learning is intimately connected to *analyzing*, *evaluating* and *creating*. This means that the *creative phase* is the level that

should be the target for any teaching practice. This taxonomy can be linked to the SOLO taxonomy (Structure of Observed Learning Outcomes), where low-level conception is categorized as *prestructural*, *unistructural*, and *multistructural*, whereas *relational* understanding can be placed as an intermediate step to high-level cognition, i.e. *extended abstract* [1]. At the beginning of university studies or a course, the students will experience a lot of unconnected and in their view isolated information, which they will be able to gradually connect without understanding the significance. They will be able to do more connections on various domains, but still the significance will not be understood as a whole until the next step. At the *extended abstract* level, students will consider previous knowledge, which means they will, e.g., hypothesize, theorize, and create. A crucial strategy to achieve deep learning is motivation of the individual

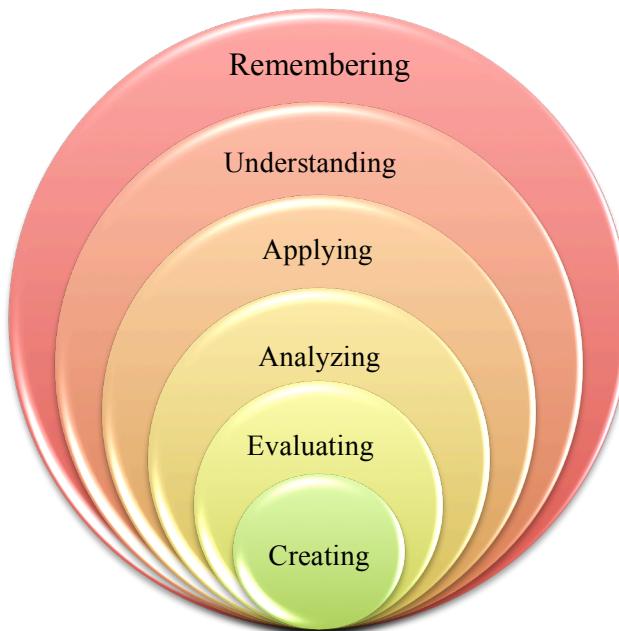


Figure 1: Blooms taxonomy (revised).

student, being categorized in four classes: *extrinsic*¹, *intrinsic*², *social*³, and *achievement*⁴. In a classroom, the teacher typically carries the responsibility that all students need to feel motivated and stimulated. This poses a challenge in a course on master level where students tend to be heterogeneous, e.g., from students who just finished the Bachelors to professionals that have several years of work experience. It becomes obvious that it can be difficult to achieve extrinsic and intrinsic motivation on an individual level. If the learning objectives are too high, less experienced students will feel a too large gap between their current knowledge level and the goal. It would be very likely that these students mentally surrender before they even try to learn. If the goals are too low, i.e., the knowledge gap too narrow, the more experienced students will most likely not be challenged in doing there best. Thus, it is necessary to develop a teaching strategy that results in sufficient extrinsic and intrinsic motivation for a heterogeneous class.

Social motivation is seen as a superior encouragement strategy, and disadvantageously, often considered to be outside the teachers' playground. However, if scenarios that trigger social motivation are carefully implemented in a course curriculum, it becomes very likely that the performance of individual students is boosted.

This article presents how the aforementioned strategies are implemented in a project course on master level. The proposed strategies can be adapted to courses that have a similar setup.

2 COURSE IMPLEMENTATION

This section presents how the course is implemented by considering various means to increase the overall motivation of students in a classroom, which in turn enables deep learning.

2.1 Projects

The students are expected to work in pairs on individual selectable projects. The offered projects differ in application areas targeting the research interest of the research group at the department, e.g., biomedical applications, wireless communication, etc. The requirements of the projects are specified in different difficulty levels (A, B, C), targeting a top to passing grade, and supervision is offered by one of the PhD students. Furthermore, the projects are scalable in terms of requirements, which means that a project of level C can be upgraded to level B by including more requirements, level B can be down- or up-graded, see Figure 2. Level A is already targeting a top grade, however, even here a special upgrade will be offered. This is realized by discussing the project requirements with the students from the beginning, offering the possibility to upgrade the project to a master thesis.

The goal of this course setup is to trigger the intrinsic and extrinsic motivation. Rather than specifying a predefined, and for some students relatively high threshold, the students will have the possibility to make their own decision. Thereby, it is likely that the students will experience a positive feeling and motivation is enhanced, as the students will reach their pre-defined goal (i.e., passing a lower or intermediate threshold). This is contrarily to feeling degraded by not meeting the highest expectations, set by the teacher. Furthermore, students who were more reluctant when choosing a project, possibly become more confident and want to lift their pre-defined threshold, by implementing more requirements, enhancing individual *engagement* and *motivation*.

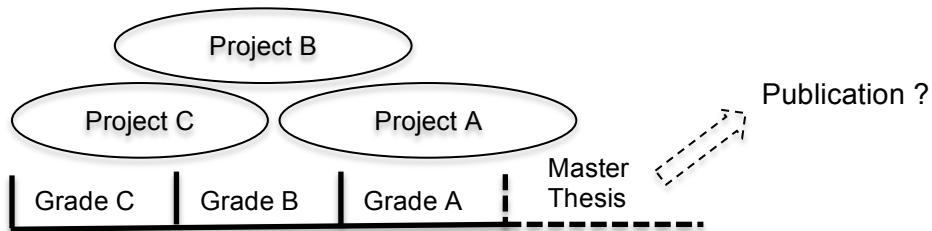


Figure 2: Projects and grades classification.

¹ what the outcome produces

² process of doing it

³ what other people value

⁴ opportunity for ego-enhancement

The projects that aim for grade 'A' are often closely connected to one of the research projects at the department, and often it is possible to continue the project as a master thesis. Thereby, some of the highly motivated students will have the possibility to work on a larger implementation, having the *opportunity for ego-enhancement* as a driving force. Moreover, having a close link to a research project gives the students the perspective of trying out how it would be being a PhD student. Students with outstanding result will be encouraged to submit an article to a local conference.

2.2 The Student Syndrome and Oral In-class Presentations

A typical recurring inquiry from the beginning a course is an extended deadline. This inquire is turned into a discussion by talking about the "Student Syndrome" [2]. The Student Syndrome describes the phenomena of humans (not only students), becoming very active shortly before a deadline. Extending a deadline would end up in the same result, with the only difference that the low activity phase would be prolonged. A technique to increase the activity level of a class is the implementation of compulsory tasks, which need to get assessed during the duration of a course, rather than having one final assessment at the end.

This continuous assessment is implemented by several oral in-class presentations, covering current status, revised time plan, and possible problems and solution. For the majority in the class, this is their 1st presentation in front of an audience ever. The presentations are given in English, and a presentation template is provided to ensure that relevant information will be disclosed. The students get feedback on the presented material and their presentation style. These presentations serve multiple goals:

- The students will present their status and receive some feedback;
- the presentation date is perceived like a deadline by the students, which significantly increases their activity level, counteracting the Student Syndrome;
- the students will realize that other students are having problems as well, and thus, their self-confidence will increase;
- they will learn about different solutions to the same problem;
- trigger discussion between the groups;
- the students will have the possibility to train their oral presentations skills.

Most likely the students will mainly focus on the first bullet. However, from a teaching perspective the other goals are of higher importance. Again, these presentations most likely trigger *social motivation*, since none of the students want to miss the possibility of making a good impression in front of the others and the teacher. From the first to the last presentation at the end of the course an increase in presentation quality is observable, as the class is becoming more mature in presenting. Furthermore, pairs working on the same project may start competing with each other, e.g., upgrade to higher level or earlier completion, triggered by *ego-enhancement*.

3 DISCUSSION

The projects require that the students will enter the deep-learning phase where they will create a new design. In order to reach the course goal, they need to synthesize knowledge they have gained during their undergraduate studies, or from the courses in the curriculum of the international master's program. Furthermore, they need to analyze and evaluate different solutions and techniques in order to create something new. In very few cases some students are not able to meet the minimum goal during the course duration. In most cases they have problems when they need to apply knowledge that they should have obtained earlier, which is necessary at the entry phase for deep learning, according to Blooms taxonomy.

After the first presentation the students often realize that they are subject to "social motivation". They will be able to position and rank the work of others, while they are realizing that this positioning and ranking is mutual. It can be observed that the activity in the class increases significantly after the initial presentation, possibly triggered by ego-enhancement.

The course evaluations show that the course is well received by the students and has a very high score on the statistic measures for "Importance for Education", "Overall satisfied", "Appropriate Assessment", see Figure 3.

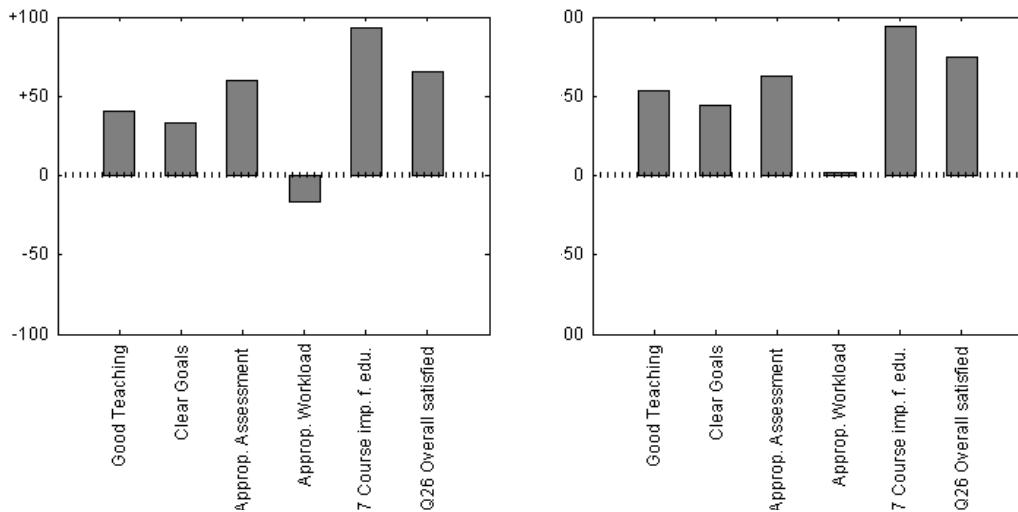


Figure 3: Course evaluation of two successive years.

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- [1] J. Biggs, "Teaching for Quality Learning at University", 2nd Edition, Open University press.
- [2] E. Goldratt, Critical Chain, North River Press