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Engaging Students in Homework Assignments and Self-Study: A Study Case

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Abstract

This paper discusses teaching and learning activities (TLAs) that foster students' commitment to homework and self-study. The discussion is illustrated with an exercise class, part of the International Master Programme in Wireless Communications at Lund University. The TLAs favored do not only look after the cognitive state and learning style preferences of the students, but they also take into account the teaching abilities of professors. An incremental approach is advocated for, in which more advanced TLAs are gradually added to the teaching and learning situation as the teacher gains in skills and confidence.

Introduction

Engaging students in homework assignments is not easy. Although students, over and over again, are exhorted to practice problem-solving on their own, it is a fact that most students attending exercise classes come unprepared. Often, exercise classes represent their first (and, sometimes, only) contact with applied calculations in the subject area of the discipline. This situation is problematic in several ways. First, the tempo of the course is usually high and, if opportunities for tutored discussions at the exercise classes are not properly used, students might find themselves not ready for the rapidly approaching exam. Second, some students do, in fact, prepare at home; those students might feel frustrated when they have to adapt to the slower pace of their classmates who didn't do their homework. Therefore, diligent student might perceive exercise classes as a "waste of time".

The most important benefit of engaging students into self-study is, however, helping them to develop as self-regulated learners (Svinicki and McKeachie, 2014). In this paper, we explore TLAs that, while supporting the learning outcomes of the course, have the potential to develop students as strategic and self-regulated learners. Strategic learners are more likely to pursue deep approaches to learning, which lead to superior retention times (Trigwell et al., 1997). One must also realize that teachers and students alike develop their teaching and learning abilities in stages, and that different individuals might find themselves at different stages of development. We believe that the variety of TLAs considered in this paper can accommodate different learning styles (Kolb, 1984) and teaching skills (Perry, 1970).

The paper is structured as follows. In Sec. “Pedagogical Framework” some concepts and theories of teaching and learning are presented. Next, in Sec. “A Study Case”, a real-life teaching and learning situation is introduced, on which general ideas are applied. In Sec. “Teaching and Learning Activities: An Incremental Approach” and incremental approach to integrating TLAs into the curriculum of a course is proposed. The paper concludes with a summary of the discussion and some conclusions.

Pedagogical Framework

The SOLO taxonomy, Structure of Observed Learning Outcomes, developed by Biggs and Collis (1982), provides a popular framework for specifying the learning outcomes of a course. The level of understanding that students possess of a specific subject is described through five stages, namely prestructural, unistructural, multistructural, relational and extended abstract, where each stage corresponds to an increasing level of complexity. The SOLO taxonomy emphasizes conscious choices that students make about their level of commitment to a given course by differentiating between *deep* and *shallow* approaches to learning (Marton and Säljö, 1976; Svinicki and McKeachie, 2014).

Kolb (1984) proposed a learning cycle comprised of four stages: concrete experience, reflective observation, active experimentation and abstract conceptualization; each stage involves different kinds of thinking skills. Kolb further hypothesized that students learn best at different parts of the learning cycle, and introduced the concept of *learning style*. Perry (1970) proposed a framework to describe the evolution of the students’ state of cognition complexity (dualism, multiplism, relativism and commitment.) A successful approach to teaching should recognize that each teaching situation is an amalgam of individuals at different states of cognition complexity and with different preferences of a learning style, and should provide learning opportunities accordingly.

We shall not forget that each teacher can only approach a certain teaching and learning situation from her own state of development. Kugel (1993) proposes a path for the development of the teaching skills of college professors comprising three stages; at each stage, professors focus on a different part of the trichotomy self-subject-student. Stage 3, where the focus is on the student, is further subdivided into student as receptive, student as active, and student as independent Only when the teaching skills involved in the current stage of development have been mastered and the professor has reached a certain level of confidence can she move on to the next stage of development as a teacher. (It should be noted, however, that not all professors will necessarily go through all the development stages, nor will they necessarily do so in the order presented.)

It is also convenient to introduce at this point the notion of *threshold concept* (Meyer and Land, 2006). A threshold concept is an idea or principle that is particularly difficult to grasp by the students but, once mastered, opens up a new panorama of understanding into a discipline. Threshold concepts have a great transformational potential (Svinicki and Mckeachie, 2014) and, consequently, exposing them and grappling with them might be a good investment of class time.

A Study Case

As a study case, we choose the exercise classes of the course "Radio Systems", in which the author participates as a teaching assistant (TA). This course is worth 7.5 credits and is taught during the first year of the International Master Programme in Wireless Communications[1] offered by Lund University, Lund, Sweden. It aims at providing an understanding of how fundamental building blocks work together to build up a complete, modern radio system working under realistic radio propagation conditions. The emphasis is on enabling students to reason critically about system requirements, limitations of practical realizations, and the inherent performance-cost tradeoff.

Lectures happen twice a week and are taught by the course lecturer. In addition to the lectures, every week there is a two-hour exercise class, which is led by the TA. The collection of problems that will be discussed during a particular exercise class is provided in advance, but the solutions to those problems are not. Concise solutions, as opposed to detailed, step-by-step ones, are provided *after* the corresponding exercise class. It is also important to mention that attendance to the exercise classes is not mandatory; in fact, no list of attendance is kept. Moreover, hand-ins are not required and no reward is given to those students who actively participate in the exercise classes. Nevertheless, students are expected to produce their own solutions to the weekly collection of problems prior to the exercise class.

Here is a table showing the learning outcomes of the course (Biggs and Collis, 1982), classified according to the required level of understanding for a passing grade.

	Learning Outcomes[2]
Knowledge and understanding	• Understand how a complete radio system is designed on a schematic level, both in the general case and for existing systems. (define; describe; sequence; compare/contrast) • Understand both the function of building blocks used when designing a radio system, as well as their impact on the overall radio system performance. (part/whole; relate; analyze)
Skills and abilities	• Be able to perform the basic dimensioning of a radio system, where all parts of a traditional link budget analysis are present. (do simple procedure; combine) • Be able to make correct reflections about the reasonableness of obtained results when performing such a basic radio system design. (apply; reflect)
Judgement and approach	• Be familiar with the terminology used and be able to discuss system design proposals with other engineers in the area (define; compare/contrast; formulate questions) • Be able to assess new knowledge in the area and to a certain extent decide on its applicability in a certain system design situation. (apply, reflect)

[1] http://www.lunduniversity.lu.se/lubas/i-uoh-lu-TAWIR.

[2] From the course syllabus, at http://kurser.lth.se/kursplaner/14_15%20eng/ETIN15.html.

It is worth noting that most of the learning outcomes correspond to a complexity level of "relational" requirements or lower, as one could expect from a level-A course; only two of the learning outcomes have a requirement on the students being able to reflect beyond those particular examples they have seen during the lectures and exercise classes. (A learning outcome of type "reflect" corresponds to an "extended abstract" complexity level.)

Teaching and Learning Activities: An Incremental Approach

The following is a (non-exhaustive) collection of TLAs that can promote the development of students as strategic, self-regulated learners. Each TLA is explained in some detail, and applicable action verbs in the SOLO taxonomy (Biggs and Collis, 1982) are listed. As discussed in Sec. "Pedagogical Framework", the set of TLAs that can be successfully applied to a certain teaching and learning situation is a function of the students' experiential learning preferences and state of cognition complexity, as well as of the teacher's current stage of development (Kugel, 1993). This last point is often overlooked by teaching techniques, which focus mainly on the development of the students. Consider, for example, the situation of a novice TA. This person, not quite at easy with the contents of the subject matter and, perhaps, having limited teaching experience, might feel uncomfortable selecting advanced TLA types like "peer-correction" or "student-designed problems". On the other hand, managing "participative discussions" and supervising "whiteboard presentation of problem solutions by the students" might be perceived as more commensurate challenges. On the next course edition, however, after having gained some experience and having accrued some teaching skills, the TA might be more willing to incorporate some of the more complex TLAs to his/her repertoire. Based on this observation, we propose an incremental approach to teaching in which TLAs of increasing complexity are added to the course curriculum as the teaching abilities of the professor or TA blossom.

<u>Whiteboard presentations of problem solutions by the TA</u>

This is, perhaps, the TLA form most often encountered in practice. It is suitable for presenting model problems in an effective, controlled form. (Define, do algorithm, combine, classify, analyze, apply.)

<u>Participative discussions</u>

This is, probably, the simplest way to engage students into constructive discussions and critical thinking, since it requires a low preparation effort. In its basic form, the TA introduces a problem and, possibly, breaks down the problem into smaller questions. Questions are answered by students. Each answer provided is subject to discussion and analysis by peers. The goal is that students recreate the chain of thought conducive to the correct answer. It is important that the TA cultivates a class atmosphere in which (all) questions are welcome. (Identify, define, describe, compare/contrast, explain causes, sequence, analyze, relate, reflect.)

Whiteboard presentations of problem solutions by the students

Volunteers are kindly requested to present their solutions in the whiteboard. Help from peers or from the TA is allowed. While, perhaps, less participative than the previous TA, this TA form might be better suited for problems involving numerical calculations. At the onset of the course, the TA makes clear that students are expected to volunteer for exercise solving at least once during the course of the course. (Do simple procedure, do algorithm, explain causes, sequence, analyze, apply.)

Peer-correction

The class is divided into small groups. Students within each group compare solutions with each other. Where discrepancies arise, students discuss which one is the "correct" solution. Te most important part of this TLA form is enabling the exchange of arguments during the discussion, and to promote critical thinking: correctness is only a by-product. Indeed, it might be revealing to examine some of the wrong solutions, and which flaws in the argumentation lead to them. This TLA can be combined with TLA "whiteboard presentations of problem solutions by the students". (Compare/contrast, explain causes, analyze, reflect.)

Student-designed problems

This is, arguably, the most advanced TLA that we consider in this paper. Students go from problem solving to problem synthesis. A profound understanding of the concepts treated in the course and of the relations among those concepts is required, especially when creating new kinds of exercises that deviate from well-known archetypes. Providing complete and correct solutions is also a part of the assignment. Student-created problems can then be tackled by peer groups, which provide feedback on the soundness of the problems, and on the perceived degree of difficulty.

Post solutions in advance

Detailed solutions can be made available in advance of the exercise class, perhaps in the form of a video recording. In this way, more class time is made available for discussions.

Study groups

Students are encouraged to form small *study groups*, which meet, for example, several days a week. The idea is that students, perhaps inspired by peer efforts, mutually strengthen their commitment to develop as strategic, self-regulated learners. While this TLA might be valuable, e.g., to those students finding the course difficult, it might not be well-suited to all learning styles. Hence, it is okay if some of the students decide not to go into any study group.

Muddiest point

Classroom assessment techniques (CATs) are simple in-class activities designed to provide feedback on an ongoing teaching and learning situation (Angelo and Cross, 1993; Helgasson, 2005). The muddiest point is one of the simplest CATs. The students are simply asked to write a short answer to the following question: "Which one of the problems did you find most confusing, and why?"

Summary and Conclusions

We have looked into the important issue of helping students to develop as strategic, self-regulated learners through engaging them into homework assignments and self-study. To this purpose, a variety of TLAs that can appeal to a broad audience and that can accommodate different kinds of teaching skills have been presented. Furthermore, a professor-centered, incremental approach to integrating those TLAs into the curriculum of a specific teaching and learning situation has been proposed. Illustrating examples extracted from a real-life teaching and learning situation at Lund University have been given.

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