

Reinforcement of knowledge acquisition in course chains using student-held seminars

Wolfgang Birk and Khalid Tourkey Atta

Abstract—This work in progress paper presents an approach for knowledge reinforcement of students by introducing student-held course seminars reflecting back on the knowledge from prior courses relevant to current course topics. The paper discusses the motivation of the approach, its practical implementation, and observation made during two consecutive course instances. Further, course evaluations are used to reflect on the efficacy of the proposed approach and its future refinement.

Index Terms—Seminars, student-held, connected content, reinforcement

I. INTRODUCTION

In nowadays engineering education programs for cyber-physical systems, courses are interdependent, meaning that later courses rely on the students' ability to make use of the knowledge from previous courses due to the amount of material that need to be covered, leaving little room for repetition of knowledge from prior courses. Moreover, industry have a need for engineers which both have a fundamental depth in knowledge and being able to work in cross-disciplinary teams, resulting in engineering education needs to balance breadth and depth, as argued in [1].

In the control engineering education at Luleå University of Technology an aligned course chain was introduced to enable students to acquire knowledge on a vast number of concept, exhibiting the above problem. The problem is further aggravated as the courses are taught by different lecturers and teaching assistants putting different levels of emphasis on concept. In some cases the teaching assistant are only assigned to a specific course once. It became obvious in the later courses that students were not able to connect the different concepts and understand their limitations and applicability aspects. Thus, the knowledge, which was expected as a prerequisite, was not sufficiently well established.

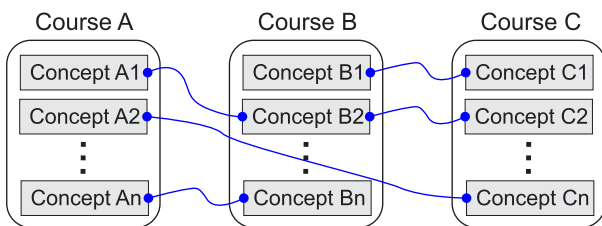


Figure 1. Concept dependencies between different courses in a course chain

In Fig. 1, the dependencies of concepts between courses in a chain is shown. Clearly, there can be different levels of

dependencies and as soon as an underlying concept is not well understood, the achievement of the learning objectives in a course is jeopardized. These dependencies may easily span several courses and especially the dependencies can be nested. A nested dependency can be seen in the concept chain $C2 \leftarrow B2 \leftarrow A1$. While dependencies in consecutive courses are quite easy to detect, this might be more difficult for dependencies to courses which are taught earlier in the course chain, like the dependency $Cn \leftarrow A2$.

This issue is not new and there are approaches on a program level to deal with such challenges, where the conceive-design-implement-operate (CDIO) approach [2], has become very popular. To what degree CDIO and problem/project based learning (PBL) can become complementary is discussed and contrasted in [3]. While a well structured program will resolve many of the dependency issues, it is difficult to deal with them on a course level. This study suggests an approach which can be implemented on a course level and thereby is able to complement the CDIO and PBL approach with a mechanism to reinforce the knowledge acquisition by the students.

Therefore, this paper proposes student-held seminars in which students discuss concepts from prior courses which are a prerequisite for the understanding of concepts that are about to be introduced. Thereby, re-learning and deeper understanding is enabled for each individual student. Student which are not sufficiently familiar with the concept are then given the opportunity to review prior course material and increase their chances to understand the new concepts.

II. APPROACH

The student-held seminars requires several working steps in the course preparation but also a well-defined setup for the students to be able to provide insight-full seminars.

The objective of the seminars is therefore to

- 1) refresh the knowledge of all the students in the class;
- 2) harmonize the understanding of the needed fundamental concepts in the course;
- 3) have the student to present technical content and discuss it with peers;
- 4) prepare the students for the upcoming course materials of the lecture.

We will now use Course C as the current course in the chain to describe the approach step-by-step:

- 1) The lecturer supported by the teaching assistants analyzes the concepts which are taught in course C and on what priority taught concepts those depend. Essentially, a dependency diagram as shown in Fig. 1 can be derived.

This has to be done well ahead of the course start and should re-occur to consider changes in the prior courses A and B .

- 2) For each concept an associated seminar topic will be defined which reviews and discusses the concepts A_i and B_i . The topic need to be described detailed enough to enable the students to be focused and concrete in their derivation of the seminar.
- 3) The seminars are scheduled to occur before the associated lecture.
- 4) Student groups will now be assigned to the seminars
- 5) The student groups are obliged to provide the presentation material to the lecturer or teaching assistant to review correctness and give valuable feedback prior to the seminar.
- 6) During the seminar the lecturer and/or teaching assistant will be present to step in and answers questions or provide additional important insights. Mainly, the lecturer or teaching assistant act as a moderator. All participants in the course are encouraged to asks questions and especially indicate which difficulties they have with the concept(s).
- 7) The seminar material will be made available to all participants after the seminar.
- 8) On the basis of the seminar the lecturer will then introduce the associated concept and present it to the students.

This approach is well aligned with the thinking presented in [4] where the critical concepts are identified from the analysis of the "concept inventory tests". It is the belief of the authors that the proposed concept can be used as a complement.

The proposed approach enables the lecturer to identify gaps in the student knowledge, enabling adaptation of the course content. Further, the discussion of of prior concepts can also provide the motivation for more advanced concepts when limitation of the prior concepts are addressed by the new concept. Moreover, the abilities that new concepts provide will be put into the correct context.

III. PRELIMINARY RESULTS

The student-held seminars have been used in two consecutive course instances of the course R7014E. Initially, the seminars were only tailored very loosely, providing a high level of flexibility to the students. The resulted in largely varying quality of the seminars and the also the content that was discussed. In the second round, the topics more detailed more accurately and the expectations on the seminar and its content were specified more accurately.

In both occurrences, specific question in the course evaluation were used to gather feedback from the students on the student-held seminars. While the idea was highly valued, many students were questioning the effect of the seminars and specifically the quality of the seminars. Here, the layout of the seminar and the contents would need to be detailed much more rendering a higher quality of the seminars and the material.

As a lecturer, the seminars provided a tool to assess the knowledge gaps of the students as a whole but also on an individual basis as the discussion quickly revealed gaps. Further,

insights were provided which aspects needed a more thorough treatment during the subsequent lectures in the course. One further observation is also that the students became more engage in participating actively in the course.

IV. CONCLUSION & FUTURE WORK

Student-held seminars of already taught concepts is a way to review and discuss such concept and to reveal gaps in student knowledge. It also enables student to become aware of their own knowledge and and where more efforts in the studies are needed. Moreover, the approach provides a means to reinforce the learning process for critical concepts in a course chain and interdependent concepts, while there is no need for a change in the overall study program structure and implementation.

The student-held seminars provide a complementary tool on the course level and is compatible with the CDIO and the PBL approach as well as with concept inventory tests.

It can be concluded that the student-held seminars are a viable approach, but need to be implemented with great care such that sufficiently high quality seminars are given by the students. In addition, students are becoming more familiar and accommodated to giving presentations.

In the next course instance, the guidelines for the seminars will be improved and a more structured setup will be required for the seminars. Introducing peers as moderators will also be considered along with a more formal assessment of the approach.

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