Make Engineering Students Collaborate

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Abstract:

Even today, the majority of university courses still consist of lectures complemented with exercises. Lectures serve to convey theoretical knowledge, whereas in exercises students work on assignments to consolidate the knowledge they have acquired during lectures, and to relate their knowledge to daily practice. Cooperative Knowledge Spaces will support natural learning scenarios in a virtual environment.
This paper describes the experiences of a study held to evaluate a cooperative knowledge space equipped with teaching material of a presence lesson.

1 Introduction

By the orientating the existing diploma curriculum merely to presence lessons, the attractiveness of the teachings and, as a result, the motivation of the students is low. This one-way, passive style of reception leads to a decline of learning success and an extended duration of study.

For the sector of engineering, hands-on practice is very important. At the beginning of the diploma there is a high gap to this experience. To train these technical contents in a didactically more apt way, learning tools has to be provided by the teachers. Especially for the training of groups with different knowledge, collaborative and communicative options has to be implemented in the learning process, also taking into account differences between male and female students in their preferred styles of knowledge transfer and their need for assistance on learning.

The study presented here originates from a cooperation project between the Institute for Machine Tools and Factory Management (IWF) and the MuLF Center (Center a for Multimedia in Learning and Research), both at Technische Universität Berlin (TU Berlin), funded by the TU Berlin's internal teaching improvement program, "Offensive Wissen durch Lernen (OWL)". The objective of this cooperation is to combine the concepts of the ViCToR-Spaces project and the concepts of presence lessons, attempting to improve educational and pedagogical concepts and learning outcomes.

2 Collaborative Learning

In educational research, there is a growing consensus about the positive effects of collaborative learning on student achievement. Collaborative learning can facilitate the process of knowledge building by requesting students to engage in activities that are beneficial for learning when cooperatively solving a problem task or discussing and elaborating text material. [1, 2]

Many studies on collaborative learning have been conducted in the area of text processing and text comprehension. However, a recent study [3] showed that also in a more technical domain --- physics in that case --- students learning collaboratively not only performed significantly better in a post-test than students learning individually, but also subjectively had a much more positive learning experience.

One important goal of research on (*computer-supported collaborative learning (CSCL)*) [4] is to bring these positive effects of collaborative approaches into e-learning. Studies on the application of CSCL methods in technical disciplines have yielded encouraging results, most notably in the context of the “Virtual Math Teams” project [5].

ViCToR-Spaces (see below) is intended to be a collaborative e-Learning and e-Research platform for technical disciplines. Within the OWL-funded cooperation project mentioned above, the feasibility of using ViCToR-Spaces in the context of a large first-year engineering lecture is to be studied.

3 Course „Fertigungstechnik“

The Technische Universität Berlin has changed the diploma to bachelor and master study course. “Fertigungstechnik” (assembly technology) is a compulsory course for the first-year students of mechanical engineering and can also be elected by students of “IT in mechanical engineering” and for teaching post. About 200 students take the courses in each term.

The “Fertigungstechnik” is held as an upfront presence lecture in two periods per week each semester. Besides this, two more periods per week are occupied by a practical laboratory seminar (“Übung im Versuchsfeld”). Both parts are tested in a written exam.

With the addition material of the seminar the learning for the written test of the lecture could be easier, but the basis for a successful certification is the development of special didactive learning tools embedded in the courses.

4 ViCToR-Spaces

ViCToR-Spaces [6] is a project currently under development at the Center for Multimedia in e-Learning and e-Research (MuLF) at the Technische Universität Berlin. The project aims at providing a cooperative knowledge space meeting demands of learning, teaching, and research in the fields of engineering, mathematics, and natural sciences. Amongst others these demands include the detection and presentation of formulae both in content and communication interfaces, as well as the integration of virtual and remote laboratories. Documents are not only simply presented to students, but may also be edited cooperatively and organized into virtual rooms. These rooms serve as a virtual meeting place where students and teachers may not only manipulate documents, but also discuss and share them. To this end, each virtual room is provided with optimized cooperation tools such as mathematics-enabled forums and chats.

As social aspects become more important in pedagogical concepts of e-learning [7], the concept of ViCToR-Spaces combines multiple types of social software in a room-based system [8], such as Wiki concepts, social bookmarking, and social networking. But ViCToR-Spaces not only aim at crosslinking users, also every kind of content in the system can be linked to other objects. In this way rooms, content pages, documents, and users build a semantical network in the system.

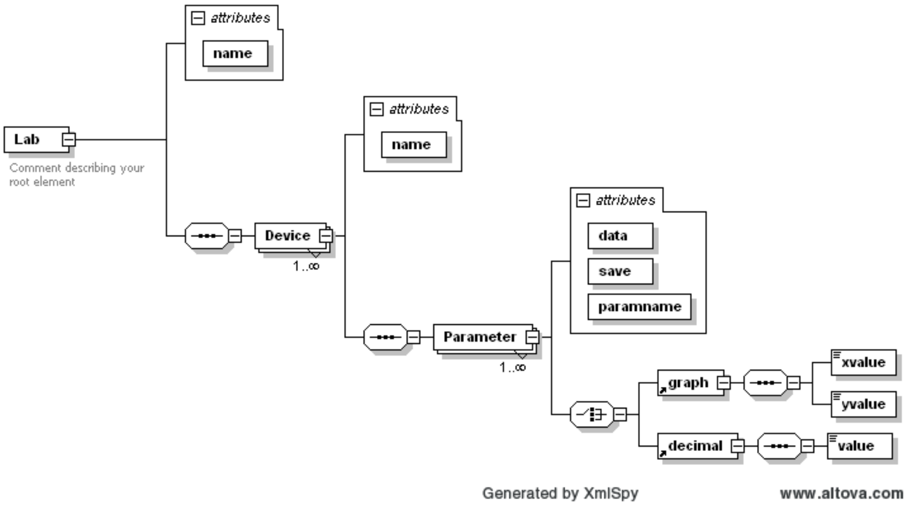

Fig. 1 XML Schema of Meta-data description of laboratories

Content pages, documents and rooms provide meta-data regarding the respective scientific field and their semantic relation among one another. Virtual and remote Laboratories are equipped with meta-data regarding the (virtual) devices and the respective input and output parameters (see figure 1).

ViCToR-Spaces is based on CURE, a room-based CSCL platform developed at Fernuniverstität Hagen [9,10].

5 The Study

The study was held over a period of two weeks in parallel to the theoretical lecture and the practical seminars as a "virtual course" in ViCToR-Spaces. The students were able to virtually rework their material and build virtual work and learn groups. Special rooms applied by the lecturers provided the digital material and videos for the according lecture (see figure 2). The students were able to jointly create lecture notes and discuss problems regarding the content in this room. A special exercise room provided practical task sheets and continuative material. Additionally the students could build work rooms to discuss problems in a smaller group.

Concluding the study we invited the students for a focus group discussion. In this discussion the students were asked about their experiences, their evaluation of navigation structures, awareness of the room concept, and suggestions for further development.

Fig. 2 Start page of the entrance room of the study

All participants were freshman students of Mechanical Engineering at the Institute for Machine Tools and Factory Management (IWF) at Technische Universität Berlin (TU Berlin). They had no previous knowledge on working within virtual cooperative knowledge spaces but had already worked at least with some classical content management systems (amongst others with Moodle[11]).

The results of the focus group discussion with the students will be outlined in the next paragraphs.

Functions – Navigation – Problems As a first summary the reactions of the students on working with ViCToR-Spaces were partially very diverse.

In first place the students didn't realize the difference between a content management system such as Moodle and a room-based system such as CURE, but working with CURE they found intuitional.

Regarding e-Learning the students are used to a content-oriented behaviour: “What can I get here? What's in here for me? How can I get something fast?” That is why they didn't realize the cooperative aspect of the system. Due to the existence of a ready-made lecture note provided by the lecturer the students didn't see an advantage in writing down their own (if they have some) in a cooperative way. They balked the additional time expenses and regarded cooperative lecture notes as a waste of time.

Also, in the students' opinion they have to solve the examination questions alone so they also want to learn alone. This is also the reason why they would decline cooperative learning scenarios such as scripted cooperation.

Suggestions In the students' opinions, a quiz to control their own knowledge would give the system an added value. With this feature they can check the knowledge they just acquired. Also, they would like to know who else is in the system (not only in the same room). Imaginable is a "buddy search" to find out if a student's buddy is online and in which room he or she is at the moment.

Although the students assumed that in case online learning (and especially CSCW – *computer-supported cooperative work*) will be established in the next years even fewer students would attend the lectures, they would appreciate an online registration system to handle all the organizational questions.

A special wish (and yet very visionary) was a so-called “Ask Dr. No”: They ask a specific question and get a definite, correct answer described in detail. Or they have to answer a question and in case they give the wrong answer, they get the correct answer and a detailed description of the approach.

6 Lessons Learned

Due to different reasons we did not succeed in making the students collaborate. The most important one might be the mistiming of the study in the mid of the semester shortly (two weeks) before the students had to pass a written test as part of the practical laboratory (“Übung im Versuchsfeld”). But it was not only because for lack of time that the students adhered to their known learning and study techniques. As they were not used to work in a virtual cooperative environment they missed some sort of demonstrations, explanations and example scenarios to understand and learn more on the new possibilities.
Furthermore since the room concept of ViCToR-Spaces is not yet (or only in a very poor way) visualized, the students did not experience a feeling of groups and rooms. It turned out that the course “Fertigungstechnik” was not a well chosen subject, because its issue is more or less a simple memorizing of facts and the provided learning material consisted mainly of explanative texts. It was something to consume rather than to work on.

The students did not see the differences to classic content management systems, so they were not motivated to adopt to a new system. Further developments have therefore to concentrate on creating an experience of rooms and groups, finding and integrating adequate “act-on” material and on developing a well understandable introduction.

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