Collaborative Development of a Joint Web-Based Software Engineering Course across Countries

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Abstract - The intention of this project was to enable the usage of shared materials for software engineering courses in seven universities located in four countries: Germany, Bulgaria, Serbia and Montenegro, and the Former Yugoslav Republic of Macedonia. All participants play active roles by making contributions to the course materials and conducting courses in their home universities. This has led to novel aspects for our project: namely, its multi-lateral character and a plethora of interesting contributions from different educational environments. These unique elements impacted on both the nature of the course material and the management of the project.

Index Terms – Higher education, multi-lingual, software engineering course, web-based materials.

BACKGROUND AND ESSENTIAL TASKS OF THE PROJECT

From 2002 to 2004 seven universities of four countries have developed a web-based software engineering (SE) course as part of a general computer science (CS) curriculum. The unique features of the course are:

- dealing with the challenges coming from different languages of the project participants,
- appropriating the course to different educational requirements,
- distributing the course material over the internet.

This paper addresses issues concerning the particular course materials to be produced in such an environment and the wherefores of project management. The main objective was the introduction of an SE course for southeast European universities based on materials and experiences of the German partner. The course used at the German university provides not only a comprehensive introduction to the field of SE but also electives from the wide spectrum of SE subfields as recommended by References [8] and [2], both with a consistent methodology. The course should be offered in the 3rd or 4th year of a general computer science (CS) curriculum. The prerequisite is a fundamental education in (object-oriented) programming with an introduction into other CS fields (e.g. theoretical CS).

Knowledge dissemination and the reduction of expenses (reuse of existing slides, exercises, case studies etc.) were the original aims of the project, however, over time, the targets and the character of the project have changed considerably: With the contributions from participating partners, new materials have been developed as a response to the feedback and suggestions of professors and their students. Due to the additional information the project had to face and overcome organizational challenges to coordinate the work.

Besides particular project management issues, there were also special problems concerning course materials to be solved: To aid professors/lecturers, particular instructional materials were designed for the lectures, the assignments and the case studies. Although English was not the native language of any of the participants, it was chosen as an intermediate language for development of course materials to enable easier translation into other languages, if necessary.

There are similar approaches presented in the literature concerning SE education: In the SWENET project [6], the participants jointly produce and share SE course materials. As opposed to our project, in SWENET the project team consists of a larger group of experienced SE educators, and there are no multi-lingual problems since English is their common native language.

Saunders’s project presented in [5] has an important feature in common with our project: an existing course has to be transferred to another university. However, the supporting London university takes full responsibility of the course materials as well as of conducting the courses at the supported Hong Kong university, i.e. both sides are not equal partners.

The International Software Engineering University Consortium ISEUC [2] is aimed at offering SE courses globally via Distance Learning. As opposed to our project, in SWENET the project team consists of a larger group of experienced SE educators, and there are no multi-lingual problems since English is their common native language.

As one of the bigger projects, the so-called MuSoFT project [3] with participants from eight universities has to be mentioned. The primary goal of this project was to produce SE course materials that are reusable in different environments. As opposed to our project, where a whole introducing SE course had to be built up, MuSoFT focused on developing learning units of varying types to suit the individual needs of different lecturers. These learning units are expected to be combined to or used in different courses. Multilingualism was not considered because German is the common language of all participants and thus became the language of choice.
To continue with the details of our project, the next section will give an overview of the course materials and of the project management materials. Section 3 is devoted to the developed course materials while section 4 will deal with the project management issues. The experience with the first courses based on the developed materials is the subject to section 5 while section 6 will provide a summary of our work.

The whole SE course has been structured into 28 topics like ‘software process models’ and ‘software metrics’. The contents and syllabus part of the project homepage (cf. Figure 1) provides an overview of them.

The course materials evolved over time. Using contributions of all partners, materials for new topics (e.g. “Extreme Programming”, “Rational Unified Process”, and “Software Maintenance”) were produced and existing materials have been extended.

**I. English as a joint language of the course materials**

Since the basic course materials have already been developed in German, the original plan in 2001 was to translate them into English. Then, either the English slides could be used as a basis for the lecturer or they could be translated in a second step to the native languages. The current state in 2004 will be discussed in section 5.

Meanwhile, it turned out that it remains an open question whether or not the translation to native languages is necessary at all. However, there is a fundamental rule to support the translation process - use slides with pictures enriched by short explanatory text fragments: they are the easiest to translate.

**II. Lecture notes**

Of course, slides alone are not sufficient for a new lecturer to conduct a presentation. To provide support, we introduced lecture notes to serve as a guide for the use of the slide material (cf. Figure 2). Lecture notes are included for the whole lecture as well as for each individual slide.

To structure the lecture notes, we introduced keywords. For example, ‘contents’ delivers additional information about the contents of a slide; ‘methodology’ has to do with how to use the slide in the lecture; and ‘answer’ gives the answers to the questions posed by the slide.

**OVERVIEW OF PROJECT MANAGEMENT AND COURSE MATERIALS**

Figure 1 provides an overview of the different kinds of information to be found at the project website [7].

The information falls into two categories: materials for project management and materials for the course. Under project management is included information on the participating universities, the project schedule, a discussion forum, update management rules, course material style guides, and responsibilities of participants.

Obviously, lecture slides cover only one part of the course materials. To enable the project to present courses approximating live lectures (as close as possible), we provide assignments, literature, case studies, and other information, too. To be able to transfer the course to another university, there are salient instructions to allow the lecturer to adapt the material.

This process is supported by lecture notes which contain guidelines for the teaching staff, a pool of case studies and assignments from which convenient ones can be selected. Under duration is kept information on the average time needed for each topic to present it in classes. This duration information is collected and continuously updated by all presenting lecturers.

Although students are expected to attend regular lectures, the course as a whole could be called web-based. All documents the students need are published at the course website: the slides in PDF-format, case studies, assignments, tool information, literature recommendations, schedule, etc.

**COURSE MATERIALS**

The slides form the basis of a live lecture. However, they have to be accompanied by supplementary materials to aid presenters of the course. The most important course materials are the subject to this section.
The title slide contains particular notes concerning the whole topic: the original author of the topic, the modification history, the overview information of the topic contents etc.

Lecture notes are not a separate document file but a part of the slide file (note part of the PowerPoint slide file). The table form (cf. Figure 2) proved useful and can easily be generated from PowerPoint files.

### III. Case studies

SE courses are usually accompanied by case studies to be discussed in the lectures and assigned for further work. Our goal is to offer a pool of case studies from which the local staff can select the most suitable ones. This wide variety of case studies should contribute to the flexibility of the course.

Presently, we are including two case studies reused from the original course, one from an administrative application and the second from a technical application. The project participants contributed additional well suited case studies. These case studies are not included in the course so far, because teaching materials for them still have to be prepared.

### IV. Assignments

In addition to this pool of case studies, we also collected a pool of assignments. They refer to the course contents as well as to the case studies which form the basis of particular exercises. We collected not only the tasks of the assignments but also sample solutions and correction hints - solutions to SE assignments are normally not unique.

Typical tasks of the assignments include: reviews of requirements specifications, object-oriented modeling practices, performing cost estimations, applying test case determination methods, automated regression testing, and evaluating software metrics. In all assignments the students are expected to practice teamwork. In several assignments they have to use software engineering tools (see also VI. Tools).

The results of the assignments are compared and discussed by the teaching staff across universities. This leads to sample solutions which are made available to all lecturers through the project website [7].

### V. Literature

In our project setting, we made the experience that existing acknowledged international textbooks are too expensive for most of the students in our southeast European partner countries. Therefore, our course materials are mainly self-contained. Additional reading recommendations exclusively consider recognized textbooks (e.g. Sommerville) available from local libraries and free documents from the Internet.

### VI. Tools

A special property of the original course held in Berlin was the inclusion of several CASE tools by presenting them in lectures as well as asking of the students to use them in assignments. Among these tools were tools dealing with object-oriented software processes (UML), requirements driven testing, software metrics, and configuration management.

Not all of the tools were reused in the transferred course. Due to financial limitations of the southeast European partner universities only the open source tools, which are available for free, could be included.
Because our project received substantial funding from DAAD, yearly workshops and coordination meetings were possible. Partners from SEE were enabled to stay at the German university several times in order to work on project tasks like translating existing and preparing new materials.

The rest of this section provides an overview of the contributions of the participating universities and discusses the strategies introduced by this project to allow synchronization of the work over the Internet in more details.

I. Contributions of the project members and their roles in the project

In the beginning, there was the straight-on plan to take the original German course and to transform it in a two-step translation. However, besides the proposed translation task, there were a lot of new contributions by the participants (Figure 3). Because of the diversity of tasks, it was important to define roles and assign limits to modifications to course materials.

The most important roles in our project are: project manager, website administrator, developer, translator, provider of lecture notes, user, and modifier.

II. Slide style guides

To assure a unified appearance of the different course topics, we defined slide style guides in the same way as there are coding style guides for programming languages.

For example, it was defined, that headings have to be unique for each slide, that colors should be not too dark and readable when printed as well as when presented in the class, and so on.

### Review report: review object (topic), version, reviewer, date

1. General remarks and impression of this topic
2. Content errors and misspellings in the slides
3. Physical errors (e.g. wrong animation)
4. Slides with a bad style and suggestions for improvements
5. Additional suggestions for improvements and extensions of the topic
6. Remarks on lecture notes

**FIGURE 4**

**REVIEW REPORT FORM TO ASSESS LECTURE TOPIC SLIDES (EXCERPT OF MAIN POINTS)**

### III. Review reports

Course materials are the product of our project activities. As a special kind of software, course materials could be assessed by the well-defined review technique. Adapted to our special needs, we developed a review report form (Figure 4). Review reports concerning a particular topic are collected, evaluated and lead to agreed modifications of the course materials.

### IV. Update management

All participants are not only allowed but also requested to contribute to the course materials. To assure a consistent database of course materials, we needed a well-defined update procedure. There are four main rules of our update policy:

- There is only one current slide file for each topic which is stored on the project server.
- Only one party is allowed to modify one topic file at one time. If a topic is under modification it is marked as being “in update by…” on the project server.
- Only the web-site administrator is allowed to physically exchange one current topic file with a new one. He will usually do this on demand of the modifier.
- To make the modification process traceable, a topic’s version is identified by its “release” date and all modifications thereafter have to be documented by the respective modifier.

Of course, it is necessary to assess the results of the update process. Modified topics are reviewed by their original author. If there are any issues raised, they will be discussed and solved in a cooperative way between author and modifier.

Since most materials are in binary formats and are not changed concurrently there was no urge to apply a complete configuration management. However, previous versions are archived to be used as fallbacks in case of problems.

### COURSE APPLICATION

Meanwhile, there were the first lectures based on the produced materials. These lectures held in Novi Sad and Skopje used English slides while speaking in native language. The students did not object to English course materials. On the contrary, since English is the definite language of international exchange in informatics, students found this solution encouraging and a challenge.

Thus, there was the question whether a translation into the national language is necessary at all, but, there are good reasons for both solutions. Advantages of using English material only are: reduced course material maintenance efforts by supporting only one language and the benefits of standardization. Still, a translation to the native language may be useful because national educational laws may enforce native languages, or, because it is easier for both the students and the lecturers.

These first course applications had to collect experiences whether the produced course materials proved useful for a new lecturer. The following points are worth mentioning:

- An e-mail hotline to the author of a course topic was important during the preparation phase of a lecture.
- Usage of English slides was possible because experienced lecturers gave the course.
- Feedback should be collected by review reports and usage reports.
- Lecture notes proved rather valuable. However, they were not always necessary since some lecturers had practical experience in real-world software projects.
During the current project phase – since fall 2003 – five new universities (Zagreb, Timisoara, Tirana, Sarajevo, Banja Luka) of four additional countries (Croatia, Romania, Albania, Bosnia and Herzegovina) have joined the project.

There were several additional applications of the course material in Zagreb, Timisoara, Kragujevac, and Plovdiv. Differing from Novi Sad and Skopje, these courses were taught using course materials translated to the native languages. The translations were mainly performed ad hoc and without a commonly agreed process. That situation may lead to maintenance problems – especially problems concerning version management – in the future.

CONCLUSIONS AND FUTURE WORK

The development of our SE course has been influenced by two main specific features: multi-lingual project partners and the active role of all participants to develop course materials. Altogether, 15 people from seven universities made contributions to the course material.

The challenges of this project have been overcome by a number of specific decisions concerning the course materials and the project management:

- Use of English as the joint language of the course material
- Web-based course materials accessible by all participants
- Lecture notes to support new lecturers
- Pools of collected case studies and assignments to satisfy the needs of different partners
- Review reports as a means of discussion
- Roles to define rights and obligations
- Rigorous update management for course materials
- Slide style guides to assure a unified appearance of the slide materials
- E-mail hotline to support urgent questions during lecture preparation.

Our original goals to disseminate experience and to reduce efforts in creating a new class on software engineering were reached successfully. Participants at several universities could introduce an approved and mature course with all of its parts (lectures, assignments, case studies, etc.) Both, the many years of experience and the produced materials could be reused.

The partner universities in southeast Europe experienced significant reduces (compared to earlier attempts of building new courses from scratch) of the managerial efforts for introducing the course, a benefit that can hardly be overestimated.

Compared to similar approaches [2, 3, 5, 6] for collaborative preparation and usage of joint course materials, our project contains a couple of unique features: multi-lingual project partners, a strict style for lecture notes, and a strong strategy for project management with review reports, update management, style guides, etc.

Besides that, our project shows that the process of transferring an existing course to other environments (even with different languages) can be performed successfully, as long as the issues we presented here are addressed appropriately.

The next steps will be the extension of the material, the inclusion of new case studies, the inclusion of tools to the course, the definition of guidelines to adapt a course to the special needs of a particular university, and, last but not least, the inclusion of new participants from neighboring countries (e.g. Croatia, Bosnia, Romania, Albania).

Up to now, students do not communicate or cooperate across universities. However, there is already some kind of indirect cross-university influence from the students. Their solutions to the assignments are compared throughout the whole project and they are evaluating their respective course using a project-wide feedback form. The comparison of these feedback forms is subject to future work.

Since translations of teaching materials had been done by the project partners in an ad hoc and time-consuming way so far, we are just about to define a process for this activity which will be tool-supported. A prototype of such a tool to guide the translation process by an integrated multi-lingual technical dictionary had been presented in [1]. In addition, this tool is to support the maintainability of the materials by providing a common layout of the materials for all of the involved languages.

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