Studies in Wonderland

Sharing of Courses, Lectures, Tasks, Assignments, Tests and Pleasure

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Abstract—**This paper presents plentiful and successful experiences that members of the Chair of Computer Science at the Department of Mathematics and Informatics from the University of Novi Sad collected over the years, and over the several effective, helpful, and valuable international educational projects. After the first excellent experiences with long lasting educational project supported by DAAD, we went further with one Tempus educational project, and a few bilateral projects. A universal conclusion, for each one of those was educational and multicultural success!**

Keywords-educational projects; common courses; international cooperation;

I. INTRODUCTION

The first experiences with the joint creation of teaching materials for the Department of Mathematics and Informatics in Novi Sad, started with the project established in 2001, with the support of DAAD foundation, and the "Stability Pact of South-Eastern Europe" [15].

Good experiences and cooperation, giving actual, usable results, lead to continuation of group effort and expansion of researchers involved, within one TEMPUS project [13]. This project was dealing with the whole set of courses, in order to introduce and accredit master studies in "Software Engineering" applied and conducted at several Universities.

After finishing with the large re-organizational issues, members of the Chair of Computer Science from the Department of Mathematics and Informatics in Novi Sad, continued improvement and constant innovation of individual courses through international cooperation within bilateral projects. Some of these projects are still in progress.

The rest of the paper is organized as follows. Second section gives more details about projects and their members. The third section is giving more insight into individual courses, their organization and methods of teaching and assessment. The fourth section presents feedback from students, gained as a result of a survey, while the last, fifth section offers some concluding remarks.

II. MORE ABOUT THE PROJECTS

A. DAAD Project

The idea that gathered educators around this project, was to build end evolve several university courses, starting with the course "Software Engineering".

This project, which started in 2001., and has been lasting for 11 years now, consists today of participants from 15 universities, from 9 countries: Germany, Serbia, FYR Macedonia, Bulgaria, as core members, and Croatia, Bosnia and Herzegovina, Romania, Albania, and Montenegro as associate members [2][7][8]. Goals of the project were achieved by cooperation in teaching resources development and production of an Internet based, distributed, multilingual university course in "Software Engineering". The course originated from the one conducted at the Humboldt University in Berlin, and was improved and enhanced through cooperation of lecturers participants of the project. More than that, through the usage of the mentioned course in Berlin, (Germany), Novi Sad, (Serbia), Plovdiv, (Bulgaria), Skopje, (FYR Macedonia), and Tirana (Albania) as a whole, and at other universities in part, the course had been further developed, and perfected.

The success and satisfaction with the results achieved with the "Software Engineering" course, lead to continuation of collaboration. Several other courses have been chosen to be

developed by lecturers from several institutions, at first, courses in "Object-oriented programming", "Software Project Management", "Data Structures and Algorithms", and "Complier Construction". The involvement of institutions was not that significant as with the first course, but for each of the additional courses, several interested universities, from different countries, joined their forces in order to develop them.

B. TEMPUS Project

Since the DAAD project started, and achieved the most with the "Software Engineering" course, its' natural extension was the design of a whole set of courses, forming a master studies in the field. The field itself has a long tradition of being underdeveloped in the region of West Balkans, so excellent experiences in joint creation of common set of courses concluded in one TEMPUS project [13]. It was concerned with the development, implementation, and accreditation of "Joint MSc Curriculum in Software Engineering" (JMCSE) under Tempus grant CD-JEP-18035-2003 [3][4].

Consortium of experts joined participants from Germany (as a grant holder), Great Britain and Spain, and individual experts from Bulgaria and Romania. On the other side, as users of Joint master studies, were members from Novi Sad (as coordinator), Beograd, Niš, (all of them from Serbia), and Skopje (FYR Macedonia). The project lasted from 2004. to 2007., and as a result a joint master studies were created, first students were enrolled, and joint delivery of majority of courses started.

Before this project, studies concluding with the MSc degree in West Balkan region had generally several conceptual problems:

- students usually worked individually, having only consultations with lecturers and no regular lectures/exercises;

- the list of courses was often rather broad and very theoretically-oriented;

- the most of the studies led to a general degree of MSc in informatics without particular specialization,

- The largest percentage of those finishing with the MSc degree, was pursuing an academic career, and was very rarely employed by industry.

In order to deal with the above mentioned problems, TEMPUS project was proposed with the goal to:

- create a master curriculum in software engineering according to generally accepted principles, Bologna declaration, current practice in EU, and local industry needs;

- make it joint for as many participants as possible;

- produce adequate teaching and learning materials for as many new courses as possible;

- Start with lectures as soon as possible.

After three years of joint efforts, created curriculum has been independently reviewed by the leading European professional organization "European Software Institute" (ESI, Bilbao, Spain). The review was highly positive and confirmed its quality and importance for education of software engineering professionals in the region. Even before the project was finished, during the year 2006, lectures for these master studies started in Novi Sad, Serbia, and only a semester later in Skopje, FYR Macedonia, also.

C. Bilateral Projects

Over the years, several smaller, bilateral international educational projects were organized, with the purpose of development of teaching material, and the courses as a whole. Worth mentioning is the fact that the teaching materials for these courses were created/innovated by professors who are experts for the exact area, using the most sophisticated, contemporary literature. Even more, most of the materials were jointly produced by professor from both universities, in order to create resources of a higher quality. Let us mention the most important projects:

- Joint project of Department of Mathematics and Informatics and Institute of Practical Informatics (Linz, Austria), entitled "Oberon0 as a Case Study in Operating Systems Lectures"

Project lasted from 2001-2002, and was dealing with the research concerning course in "Operating Systems". Generally it was a research project, but the results are used for improvement of lectures in this course.

Project was supported by WUS-Austria (World University Service) and Stability Pact for South Eastern Europe.

- Joint project of Department of Mathematics and Informatics and Humboldt University (Berlin, Germany) entitled "Web-based course-supporting and e-learning system for courses in informatics"

Project lasted from 2006-2007, and the research was centered on usage, adjustment, and personalization of a learning management system used at the Department in Novi Sad [5].

Project was also supported by WUS-Austria.

- Joint project of Department of Mathematics and Informatics and Deusto University, (Bilbao, Spain) entitled "Course development program (CDP+) for 'Software project management'"

Further improvements of a course created under already mentioned DAAD project have been performed within this project. As a result of a project, an appropriate textbook has also been written for students [6].

Again, the project was financially supported by WUS-Austria, from years 2006-2007.

- Joint project of Department of Mathematics and Informatics and Faculty of Electronics, Computing and Informatics (Maribor, Slovenia) entitled "eLearning support system with application of data-mining and data security"

As a sort of continuation of a project dealing with the eLearning facilities at the Department, this project also dealt with the improvements of a LMS Moodle used at both institutions [12].

This project was supported by Ministries of science of participating countries, and it lasted from 2008-2009.

III. DETAILS ABOUT COURSES

Over the years mentioned projects lasted, it was a customary fact that teaching materials for undergraduate and for master level were developed in parallel. Also, at the beginning stages of the project, a lot of courses were jointly created by professors from two (or more) institutions. Another interesting fact is that some of the courses were conducted by the same professor at more than one institution – as a regular professor at home institution, and as a guest professor at another institution.

A. Software Engineering

This, by far mostly developed course, consists of 28 topics, divided into 5 parts, covering both introductory and advanced notions of software engineering. It is designed to be used with undergraduate students, and mentioned topics represent the first important component of the course.

The second essential component of the course is usage of two complex case-studies. All of the theory presented during the lectures is applied and described on those case studies, for the purpose of better understanding. Over the years, the development of two additional highly complex case-studies has been started. These additional two were needed for the purpose of prevention of cheating within the assignments, giving lecturers possibility to change them between years.

The third vital component of the course is the team assignments. The whole pool of assignments was created, and lecturers are free to choose from it. The choice over the years depended on the course length and available time of students, on availability of licenses for usage of software needed, and naturally, on personal choice of lecturers. At various universities, from 5 to 20 teams was created per year, sizing from 3 to 5 students. During the course, assignments are given to teams, with a deadline of 2-3 weeks to solve it. A minimum number of points required to qualify for the final exam is 50%, yet at different universities, there is a distinction on how those points influence the final grade.

While the actual course conduction differs at various universities, the basic structure is the same. The length of the course varies from two-semester course in Berlin, over the one-semester course in Novi Sad, (Serbia), Skopje, (FYR Macedonia), and Plovdiv, (Bulgaria), to a 6-day crash-course in Tirana (Albania). The length of the course influences the number of topics presented, and the number of assignments given to students, but the rest is generally the same. Topics and assignments are taken from the same pool, same as the questions for the exam. There is also a shared collection of "correct answers" for each of the assignments, which assistants at different universities distributed between themselves and are using them during classes.

It is also interesting to mention here one special variation of the course, conducted for the last 5 years at Polytechnic University in Tirana. Department of Informatics from Tirana was interested to use shared experiences within their studies, but did not have appropriate teaching stuff. So, an agreement was reached to involve professor from Berlin, Germany and assistant from Novi Sad, Serbia for these purposes. Because of the obligations at home Departments, it was agreed that the course in "Software Engineering" will be conducted as a crash, 6-day course, when lecturers visit Tirana and conduct classes, while the exam is held on distance, with the help of the local teaching stuff.

Results of the project and sharing of the teaching material were very successful, first of all for students:

- Students are in a position to learn according to contemporary contents, principles and standards;

- Course compatibility, both general and particular, is achieved between lecturers from a large number of universities, their shared experiences and contributions are widely available;

- Experiences, methods, and learning activities and styles of lecturers from several different countries are adopted;

B. Object-oriented Programming (using Java programming language)

Three years after the original project started, a subproject entitled "Joint teaching materials on object-oriented programming using Java", was started in 2004 [10]. This subproject established the following main goals:

- Achieving a consensus and determine which topics of Java programming language should be selected as basic topics and which as advanced topics, and use those as the basis for the common pool of topics;

- Creation and development of common pool of teaching resources for selected Java topics;

- Design of educational network as the basis for the future collaboration and exchange of teaching materials and experiences.

Mentioned goals are put into practice mostly through cooperation in creation, perfection and enrichment of teaching resources used by lecturers from participating institutions.

The particular challenge with this subproject was the need to prepare teaching material for two levels of students. Namely, the material was needed that can be used as a basis for teaching Java as the first programming language. Still, a material was also needed that can be used for teaching Java as a second programming language, while teaching elements of object-oriented concepts. As a consequence it was necessary and challenging to prepare different versions of teaching material for variety of topics.

The situation was somewhat relieved by the fact that participating lecturers were already teaching Java as a programming language at their institutions. Translation of their teaching resources into a common intermediate language –

English, created a starting pool of lectures. Over the years, material was further developed and enhanced. Various teachers have worked on particular topics, according to their affinities and areas of educational and research expertise. Furthermore, through periodical workshops and meetings, different views, opinions and teaching styles have been confronted, and the best one chosen for each topic.

This exchange of experiences in usage of common teaching material made also strong relationships, and motivates lecturers to continue working on constant improvement and expansion of existing material.

C. Master Studies Courses

It has been recognized that some of the most important countries started requiring licensing for software engineers, long time ago [14]. Even in the lesser developed regions, such as West Balkans, both the university environment through accreditation standards, and market, through everyday demands, require well-prepared and educated software engineers. Mentioned TEMPUS project incorporated curriculum recommendations given by ACM [1] and IEEE [9] as a starting point, and then developed both the curriculum, and individual courses.

Throughout the curriculum, the organization of the courses proposed is as follows:

- **Induction layer courses** - courses that can be developed jointly, but can also at any individual institution be mapped onto existing, corresponding undergraduate courses;

- **Core courses** – from the list (and of course, from teaching materials) of core courses created by the project consortium, each institution can choose 4 or 5 courses, which are then obligatory for the students in the 1st semester. It is possible for the institution to change its choice each year, and/or to direct students to core courses of other institution members of the project;

- **Elective courses** – during the 2nd semester, students are able to choose 4 or 5 courses from the rest of core courses or from the list of optional courses offered by any of the institutions member of the project.

The whole list of courses consists of 4 induction layer courses, 6 core courses, and 12 elective courses. For each of them, the course template defines: course aims, learning outcomes, syllabus, prerequisite, and recommended method of assessment for the course.

Since the beginning of the master studies, joint efforts of the Department of Mathematics and Informatics from Novi Sad (Serbia), and Institute of Informatics from Skopje (FYR Macedonia) are aimed to enhance and promote these studies among students. Mobility of professors is continual, since the beginning, so the courses are conducted by lecturers with the best expertise in the field.

For example, professors from Skopje are conducting for students from Novi Sad, courses in: "Privacy, Ethics, and Social Responsibility", "Software Engineering for Critical Systems", "Software Testing", and "System Integration". At the same time, professors from Novi Sad conduct for students in Skopje lectures in "Architecture, Design, and Patterns", "Formal Methods Engineering", "Information Systems Development Process", "Software Project Management", "Component Based Development", "Research Methods", "Software Engineering for Database Systems", and "Software Evolution".

As an example of a course developed and lectured by joint institutions, we will mention a course in "Information Systems Development Process". This course has been for several years conducted through joint effort of professors of both universities giving lectures on topics of their best expertise both in Novi Sad and in Skopje. Today, after the combined endeavor of both sides, the course and lecturers evolved enough that it can be conducted by local teaching stuff.

Before the TEMPUS project, the course was organized as follows:

- Theoretical classes – covering theoretical topics through regular teaching classes;

- Exercises with great emphasis on practical activities, and

- Practical work in a computer laboratory.

After the completion of a TEMPUS project, the situation is rather different. The course was developed jointly by lecturers from Novi Sad, (Serbia) and Skopje (FYR Macedonia) [11]. Also, students from both countries took a part of the course at one institution, and the other part in the other one. Lecturers from two countries divided the course topics based on their expertise, but also on professional and research preferences.

During the course, apart from theoretical aspects of the content, several examples from real environment were used and discussed. Suitable tools for the actual methodologies and project management were presented during practical classes.

Assessment was based on the results of a team-work, on individual achievements within a team, and on individual presentation during the oral exam. It is especially interesting to mention that students had (and used) a possibility to cooperate in teams with the students from a different country, creating a multicultural environment.

Cooperation of lecturers from Serbia and FYR Macedonia haven't stopped there. Course on "Privacy, Ethics, and Social Responsibility" is also conducted in cooperation between two Departments [16]. This course has been conducted by professor from Skopje, FYR Macedonia, and assistant from Novi Sad, Serbia since the beginning of master studies in 2006.

IV. FEEDBACK FROM STUDENTS

While satisfaction of lecturers was never in question concerning joint creation of teaching materials, there was a bit of concern about how the students will react. Namely, majority of the teaching material and appropriate PowerPoint presentations, same as the other teaching resources in general, were in English, non-native language for our students. We did

our best to translate some of the materials, but the amount of those not translated is still noticeable. Besides, some of the resources are left in foreign language on purpose! For example, lectures for "Software Engineering" are held in Serbian, and so are the teaching resources. Yet, PowerPoint presentations that are used during lectures are left in English, so that the students are confronted with the terminology and expert phrases of the field. Similar is true for some other courses, namely "Software Project Management", and all of the courses at master level.

The other reason for our concern was the quantity of materials, assignments, and obligations standing in front of our students. Compared to other courses, it seemed that some of the requirements were rather demanding.

Being the part of a long-lasting project, all of the courses emerging from DAAD project were thoroughly checked and enhanced over the years. As a part of regular meetings of the project participants, reports on course conduction and students' satisfaction were also presented. Over the years, there were some negative responses, but those were so few, that those are really not worth mentioning. On the contrary, number of positive reactions was very large, and we will present some of them here.

As a comment of grades presented in Table I, we might also add that the best grades for both lecturers and the course were achieved on years with the highest attendance rate, and vice versa.

Except for numerical results given in a Table I, we will present also some textual comments. There were some constructive objections, in the line with our expectations:

- "The amount of lectures and assignments in the course was too much. This is mainly because the course was originally 2-terms long", or "Too big for 1 semester";

- "There should be a specific book which follows the lectures";

- "There are too many assignments for just 1 semester."

TABLE I.   GRADES FOR THE COURSE "SOFTWARE ENGINEERING"

Criteria	Year				
	2009/10	*2008/09*	*2007/08*	*2006/07*	*2005/06*
Appropriate quantity of knowledge (1-too little, 5-too much)	3.04	2.96	3.12	2.97	3.21
Appropriate lecture content (1-too little, 5-too much)	2.93	2.75	3.00	3.00	3.04
Lecturers knowledge (1-bad, 5-excellent)	4.20	3.75	4.79	4.10	4.50
Lecturer engagements (1-bad, 5-excellent)	4.53	4.68	4.91	4.64	4.46
Learn enough useful things (1-not enough, 5-excellent)	3.96	3.85	4.56	3.90	4.08
Grade for the course (1-too little, 5-too much)	3.90	3.82	3.95	3.82	4.00

There were also some praises:

- "Very interesting course. Different from other courses, and it should be obligatory for all CS students";

- "Good student-teacher relation. Students can be active and participate in discussions";

- "I like it, especially method of organization of theoretical part"

Of course, there were a number of excessive individualists over the years, who complained for being forced to work in a team:

- "I learned the light and dark side of working in teams";

- "I can't see any use of team work, except for the speed of solving the assignments. It would be better if students are offered both options – working in teams and working alone, where those who decide to work alone should be given slightly easier tasks".

Particularly important was an objection from one of the students about improper behavior of the members of her team. Namely, after reaching the required number of points for a positive grade, 2 (out of 4) members of a team decided to quit, satisfied with the minimal grade. Still, the rest of the team was torn between opposite wishes: not to betray friends telling that they quit, and the wish to reach a higher grade. Within the anonymous survey, she said "Two members of my team have the final grade same as me – 9, yet one of them have NO IDEA about the content of assignments 4 to 7."

Actually, this last objection forced lecturers to change the methodology of assignments. Instead of one final document submitted by the whole (or not whole) team, assignments were to be solved using Wiki part of Moodle LMS. This enabled us to precisely follow involvement of each of the team members, but at the same time provoked complaints by students wishing to cheat with the assignments.

Finally, the nicest remark that the course received was the following one: "I'm generally very satisfied with this course. It taught me a lot of things that were previously unknown to me, but now everything makes sense (on a global level). I understand its significance and importance. Also I've become very attached to it, and finally started to see my path and place in the future."

Besides "Software Engineering", we conducted surveys for some other courses as well. The most interesting one is in our opinion survey about the course on "Software Project Management", which shows constant improvement over the years. We suppose that it has something to do also with the ability of lecturers to go deeper into teaching material, find interesting elements in a course, and practice lectures for some years. The results are given in Table II:

TABLE II.　　GRADES FOR THE COURSE "SOFTWARE PROJECT MANAGEMENT"

Criteria	Year		
	2009/10	*2008/09*	*2007/08*
Appropriate quantity of knowledge (1-too little, 5-too much)	3.04	3.20	3.10
Appropriate lecture content (1-too little, 5-too much)	2.93	3.00	3.21
Lecturers knowledge (1-bad, 5-excellent)	4.40	4.10	4.77
Lecturer engagements (1-bad, 5-excellent)	4.53	4.10	4.93
Learn enough useful things (1-not enough, 5-excellent)	4.06	3.70	4.57
Grade for the course (1-too little, 5-too much)	4.20	4.10	3.75

We would like to add here that the course is innovated and improved every year, on the basis of discussions and suggestions of other professors, project participants. Every autumn, regular workshop of project participants is conducted, during which the exchange of experiences and opinions naturally happens. Gained views and attitudes are then incorporated into lectures and assignments, and used in the following years.

The third course we will mention here is a master course on "E-Business", which has so far been conducted as an elective course at graduate level. We do not have enough statistical data results to create a table, but we will present some grades and textual comments:

- Course is estimated to be "well structured" (grade 4.71 out of 5);

- Course gives appropriate amount of knowledge (4.42);

- Course does not require any special pre-knowledge, just the sum of general knowledge and experience;

- Lecturer is familiar with the course (4.86), engaged (4.57), well prepared (4.57), and willing to answer any questions (4.86);

- Considering the presentations used, the opinion was that they are well structured and clearly arranged (4.14), and contain adequate amount of information (4.14);

- Generally, content of the course is useful (4.29), it was important for the students that the course was "internationally supported" (4.00), and finally, the overall grade for the course was very high (4.57);

- On the comment side, we learned that "Lectures were easy to follow and interesting", "General structure of the course and topics were well selected", "My final paper topic was stimulating and up-to-date, so it was fun to do it";

- Again, we separate to most honorable comment: "Generally, this was a prolific experience. I got familiar with new terms and fields in IT, which I found quite useful. I am encouraged to do further research and reading regarding the topic".

From those, rather similar grades and comments for each of mentioned courses, we conclude that the teaching material produced is of high quality, and that students are very satisfied with it. As some experience with its usage is added, and as lecturers adjust to the material, students satisfaction and lecturers grades are becoming even higher.

V.　FINAL REMARKS

Department of Mathematics and Informatics, University of Novi Sad, has been included in several educational projects for a long time, particularly Chair of Computer Science. The first involvement with educational projects, within the DAAD project in 2001, was perhaps just a curiosity and inquisitiveness; yet excellent experiences with that project were a perfect motivation for participation in other projects of educational kind.

Gained experiences, and created teaching resources are not fixed in their current form, they are innovated and developed each year. As mentioned, participants of the DAAD project conduct regular meetings each September, on their annual workshops. Lecturers for the same courses, at different institutions, exchange experiences and findings, and based on this trade of experiences lectures, presentations, and other teaching resources get improved for each subsequent school year. As a part of these meetings, lecturers regularly:

- present achieved results in the field of education, within topics supported by the project;

- suggest ideas for innovation of teaching, and agree on application for joint and/or individual educational projects;

- present scientific and/or professional papers published between two meetings by project participants, which are connected with the main aims of the project;

- exchange experiences between lecturers and inspire innovative teaching methods and processes;

- include students, who present their views and experiences gained during studies, especially concerning the courses which are part of the project;

- Discuss plans and suggestions for the following year, and for the future work within a project.

Educational effects obtained as result of participation in different international, educational projects are obvious for professors and students at Department of Mathematics and Informatics, University of Novi Sad. The whole direction at master studies was created with the approval of international community, and a lot of courses were improved and perfected in last decade to the satisfaction of students.

While praises and acclaims within a survey might be sufficient, we are even more satisfied with the number of students enrolling to studies at the Department in general, and

choosing courses that were created through the international cooperation.

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