COMMON SOFTWARE ENGINEERING COURSE
Experiences from Different Countries

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Abstract: A joint common course has been created as a result of a project of the "Stability Pact of South-Eastern Europe" and DAAD. It has been conducted in Novi Sad, Serbia, with graduate students, and in Tirana, Albania, with master students by teachers from Berlin and Novi Sad. In this paper, similar methods used in each of these courses, and outcomes reached by students are presented and compared with the achievements within the "original" course, conducted at the Humboldt University in Berlin.

1 PRELIMINARIES

With support of DAAD and the "Stability Pact of South-Eastern Europe", a joint project was established in 1999. Idea was to build and evolve common courses in several fields of computer science, starting with "Software Engineering".

The project consists 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 (Bothe, 2003; Bothe, 2005; Budimac, 2008; Zdravkova, 2003). The main goals of the project were:

- "Software Engineering" is included into universities' curricula of all participating countries;
- Agreement on a joint course was performed, with creation of teaching, examination, and assessment material;
- Founding of e-Learning facilities was completed;

Goals are performed through cooperation in development of teaching materials, and production of a distributed, Internet-based, multilingual university course. Joint course originated from one conducted at the Humboldt University in Berlin. It covers more than 85% of the elementary lessons suggested in "Curricular guidelines for undergraduate programs in computing" (ACM 2001, SWEBOK 2001).

2 STRUCTURE OF THE COURSE

The course is conducted at several participating universities as a whole, or in part:

- At Humboldt University in Berlin, it's been conducted for a decade, for undergraduate students;
- At the University of Novi Sad, Faculty of Science, course has been conducted:
  - for postgraduate CS students, for 2 years,
  - for undergraduate CS students, for 4 years.
- At the University of Beograd, Serbia, Timisoara, Romania, Plovdiv, Bulgaria, and Skopje, FYR Macedonia, course has been conducted in different ways and durations in the last several years;
- At the Polytechnics University of Tirana, a 7-day crash-course has been conducted for 2 years.

The course consists of 28 topics covering introductory notions of software engineering.

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The second essential component of the course is usage two of complex case-studies.

The third component of the course is team assignments. An assignment pool was created, and lecturers are free to choose from it. From 5 to 20 teams was created per year, sizing from 3 to 5 students. During the school year, 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 how those influence the final grade is not the same. In Germany, number of points does not influence the final grade. In Serbia, and Albania, points gained for the assignments directly influence the final grade.

3 ASSIGNMENTS AND ACHIEVEMENTS

For the first time during the school year 2004/05 an identical complete course, with the same case studies, and the same assignments for students was held in Berlin and in Novi Sad. Later on, the same course was conducted in a different style in Tirana, but with the same general structure.

A pool of nine assignments has been created.

- Assignment 1: Review of "(preliminary) requirements specification".
- Assignment 2: Application of a function-point method on a given requirements specification.
- Assignment 3: Review of a product model resulted after structured analysis.
- Assignment 4: Development of a use-case diagram and class diagram for a given problem.
- Assignment 5: Definition of a formal specification for several given operations.
- Assignment 6: Review of a solution of the fourth assignment of a different team.
- Assignment 7: Measuring a quality of software.
- Assignment 8: Specification of a regression test.
- Assignment 9: Creation of a classification tree.

The following procedure for assignments is applied: Teams are given specific tasks and have to produce results in a given time. Later, one exercise class is organized where the most provoking solution is presented by the members of the team submitting it.

For solving of the assignments, students are divided into teams, according to their own choice. This approach has several advantages (Bielikova 2004). The first is simplicity from the managerial point of view. Second is the fact that the opportunity to sign up for a team of their choice creates an additional personal relationship within team.

There are at least two disadvantages to this approach. First, the team quality can (and usually does) vary significantly. The second drawback is that occasionally, members of the groups have complaints on the other members. While students are informed that they are allowed to "fire" their colleague from the team, this is much more difficult when team members are mutual friends.

Not all of the assignments are performed each year. Especially, the length of the course influences the choice of assignments for the course in Tirana. Another important point is the fact that the "correct solution" which is presented to students is created in cooperation, based on the combined experience of lecturers from Berlin and Novi Sad.

4 RESULTS FOR ASSIGNMENTS

Results gained at different universities, for the assignments are presented here. Number of students grows every year, yet percentage of gained points for assignments shows regular behaviour. For students from Novi Sad results are given in Table 1.

- Percentage of gained points for the first year is significantly different than during the following years. Reason for this probably is connected to the non-experience of lecturers.
- The worst results are usually gained for the assignment number 2 (the function-point method). The assignment is quite straightforward, yet it seems that it has some hidden difficulties.

Table 1: Assignment points for Novi Sad students of Computer Science.

Novi Sad	Nr of Students	Average Points Assgn 1	Average Points Assgn 2	Average Points Assgn 3	Average Points Assgn 4	Average Points Assgn 5	Average Points Assgn 6	Average Points Assgn 7	Total Points Assgn
2004	45	81,11%	66,67%	63,78%	73,11%	75,78%	88,61%	68,52%	74,05%
2005	54	73,89%	74,53%	80,38%	79,90%	80,68%	94,32%	95,45%	81,75%
2006	60	81,67%	75,42%	88,00%	75,56%	80,67%		95,00%	81,85%
2007	66	77,73%	75,99%	85,76%	77,42%	78,30%	94,38%	91,67%	82,18%
Average		78,60%	73,15%	79,48%	76,50%	78,86%	92,43%	87,66%	79,96%

Table 2: Assignment points for Tirana master students.

	Nr of Students	Average Points Assgn 1	Average Points Assgn 2	Average Points Assgn 5	Average Points Assgn 7	Total Points Assgn
Tirana 2007	17	78,24%	80,59%	80,00%	98,24%	84,26%
Tirana 2008	15	69,30%	74,00%	76,70%	95,30%	78,83%
Tirana 2008 II	15	66,00%	78,70%	80,70%	92,70%	79,53%
Average		71,18%	77,76%	79,13%	95,41%	80,87%

- Assignment number 6 (review of a solution of another teams' assignment) has the highest average percentage of points, which is expected, since it represents mostly the ability of a team to defend their own opinion.
- The best results and the highest number of points are gained for the assignment 7 (measuring of the quality of software). First, it is straightforward and relatively simple task. Second, this is the last assignment, when students are experienced of what they have to do to solve their task.
- The assignment 4 (creation of use-case and class diagrams), asking for the highest level of "creative" work, has the second worst results. The main point here is the lack of experience with the real-life work, no practical abilities and skills.
- Average total points achieved by students are sufficient for them to approach the rest of the exam. Even more, it is close to 80% of points.

At the Polytechnic University of Tirana, in spring of 2007, a 7-day crash-course for the students of master studies was conducted by professor from Berlin and assistant from Novi Sad. Again in 2008, course was conducted again, this time with 15 students from the first year, and 15 students from the final year of master studies.

These students had to solve 4 assignments: 1 (review of requirements specifications), 2 (function-point method), 5 (definition of formal specification), and 7 (measuring of the quality of software). The first one they solved before the course started, to be introduced to the requirements specification. Other three had to be solved after the course, 2 weeks per each assignment. Results are presented in Table 2.

Results are quite comparable to the results of Novi Sad students. If we disregard the first year, percentages for the same assignments in Novi Sad are 77.76%, 75.31%, 79.88% and 94.04%. The difference is not high, since students from Tirana were studying in non-mother tongue, preventing them to achieve better results as master students.

How does all this compare to Berlin students? For Berlin, statistics is given in Table 3. One thing that influenced those results is the fact that during 2007, assistant was changed in Berlin. Notice that in Novi Sad, Tirana, and Berlin (during the first two years) average percentage of points is around 80-82%, yet, inexperienced assistants had different results: 74% in Novi Sad, or 87% in Berlin.

5 THEORETICAL TESTS

The second part of the exam was tests with theory. The particular structure is different, but general form is the same. A repository of around 400 questions is created. There were 2 tests in Albania, or 3-4 in Serbia, yet in total they sum up to 60 points for tests, added to 40 points for assignments. For students from Germany, the second part of the exam is performed orally. Table 4. presents Serbian students' results achieved in tests.

Students from Tirana had only two tests, both were performed "on the distance" by a local professor, and at the same time. This is different than in Novi Sad, where tests are scheduled throughout the school year. Test results are presented in Table 5. Number of points is much lower than for Novi Sad students. The only reasonable explanation is a usage of English, non-mother language. Additional problem was the fact that the test was performed on the distance. So, problems with questions, even the lingual ones, could not be solved.

Table 3: Assignment points for Berlin students.

Berlin	Nr of Students	Average Points Assgn 1	Average Points Assgn 2	Average Points Assgn 3	Average Points Assgn 4	Average Points Assgn 5	Average Points Assgn 7	Total Points Assgn
2003	52	88,57%	78,41%	75,00%	72,27%	65,00%	86,73%	77,14%
2005	85	86,88%	80,63%	86,25%	74,67%	75,63%	78,00%	80,34%
2007	64	87,14%	87,62%	87,62%	87,62%	81,00%	91,90%	87,15%
Average		87,53%	82,22%	82,96%	78,19%	73,88%	85,54%	81,54%

Table 4: Test points for Novi Sad students of Computer Science.

Novi Sad	Average Points Test 1	Average Points Test 2	Average Points Test 3	Average Points Test 4	Total Points Tests
2005	68,07%	66,09%	66,92%	63,95%	66,25%
2006	70,41%	71,35%	67,54%	70,89%	70,05%
2007	68,63%	70,00%	54,01%	53,33%	61,49%
Average	69,03%	69,14%	62,82%	62,72%	65,93%

Table 5: Test points for Tirana master students.

	Nr of Students	Average Points Test 1	Average Points Test 2	Total Points Tests
Tirana 2007	17	58,33%	50,33%	54,33%
Tirana 2008	15	64,23%	56,43%	60,33%
Tirana 2008 II	15	67,33%	52,00%	59,67%
Average		63,30%	52,92%	58,11%

6 CONCLUSIONS

Results of the project were very successful, first of all for students:

- Students are enabled to learn according to contemporary contents, principles and standards;
- Course compatibility, both general and particular, is achieved;
- Experiences, methods, and learning activities and styles of lecturers from several different countries are adopted;

There are a lot of similarities with the results gained for the assignments. The final grade for each of conducted courses is on the average between 8,20 and 8,29 for all countries.

Considering the method of passing the exam and results for assignments and tests general conclusions are drawn out:

- Students belonging to higher years are: (slightly) more serious; get (slightly) higher number of points for the assignments and for tests; pass the exam in (slightly) larger percentage.
- Comparable groups of students from different countries have similar results: they use the common material; are confronted with the same methodology and didactics; meet the similar style, techniques of presentation and exam
- Good results with the application of common course material and techniques are a consequence of exchange of experiences and opinions of Project participants.

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