Cross-Balkan Experience in Delivering a Joint Course on Software Engineering

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Project

- "Stability Pact of South-Eastern Europe" and "DAAD - Deutscher Akademischer Austausch Dienst" since 2000, until now.,
- 15 universities, from 9 countries:
  - Germany, Serbia, FYR Macedonia, Bulgaria, as the core members,
  - Croatia, Bosnia and Herzegovina, Romania, Albania, and Montenegro as associate members.
- The goal: joint courses or teaching materials for several courses "around" software engineering
  - Reverse engineering (research)
  - E-Learning (research and usage)

The structure of SE course

- Lectures (on 28 topics)
- Case studies (2)
- Team assignments (9)
- …

Who adopted it

- Humboldt university, Berlin, since 1996
- University of Novi Sad, since 2004
- University "Ss Cyril and Methodius", Skopje, since 2007
- Polytechnics University of Tirana, since 2007, as the intensive course (held by lecturer from Berlin and assistant from Novi Sad)
- Univ. Paisii Hilendarski, Plovdiv (without assignments)
- University of Belgrade (a large subset)
- …

We concentrate on…

- 4 universities (Berlin, Novi Sad, Skopje, Tirana)
- 6 courses (2 in Novi Sad: for students of informatics and for students of teachers of informatics and X, 2 in Skopje: for students of III and IV year)
- Emphasis is on assignments and tests

All in all

- Berlin, IV year, undergraduate, informatics, local slides, language
- Novi Sad, IV year, undergraduate, informatics, English slides, local language
- Novi Sad, IV year, undergraduate, teachers, English slides, local language
- Skopje, II year, undergraduate, 3 year studies, informatics, English slides, local language
- Skopje, II year, undergraduate, 4 year studies, informatics, English slides, local language
- Tirana, II year, master, informatics, English slides, English language

All in all (contd)

- Berlin, assignments (at least 50%) and then oral. Final grade based only on oral.
- Novi Sad, Skopje, Tirana, assignments (all) and tests. Final grade consists of everything.

Assignments

1. *Review of "preliminary requirements specification" and "requirements specification".* As an example, case-study "Seminar organization" is used, and both requirements specifications are a part of it. Students have to find misunderstandings, discrepancies and errors in them and write a report with suggestions on how to solve these problems.

2. *Application of a function-point method on a given preliminary requirements.* Again, requirements specification for "Seminar organization" software is used and students have task to estimate costs, expressed in human-power, for creation of this software.

3. *Review of a product model resulted after structured analysis.* Data-flow diagrams for mentioned "Seminar organization" software are presented, taken from the book [9] together with all of the errors in them. Students are required to recognize those errors and suggest correct diagrams.

4. *Development of a part of a static model, through creation of a use-case diagram, and class diagram for a given problem.* As students already are familiar with Unified Modeling Language, use-case and class diagrams (from other courses) there is a chance here to test their creativity on a part of a static model.

5. *Definition of an algebraic specification for several given operations.* After being introduced to algebraic specification of several classic operations, students are required to develop their own solutions for some additional operations.

Assignments (contnd.)

6. *Review of a solution of the fourth assignment of a different team.* Teams were faced with another team's solution of the assignment. We tried to force exchange of solutions, which are as different as possible, between teams. Analysis of other teams' solution exposes the students to a different view on the same problem.

7. *Measuring a quality of a given software, and commenting on a certain aspects of software quality in accordance to the previously given lecture.* Again, "Seminar organization" system is used as a case-study that is to be measured.

8. *Specification of a regression test.* After learning about software testing techniques, students are required to develop a regression test package for the given example program, using the given testing tool.

9. *Creation of a classification tree.* Aim of this assignment is to practice the usage of Classification Tree Method for function-oriented tests. Students are expected to specify a systematic test for a given business process, from the requirements specification for "Seminar organization" case-study.

More on assignments

- Teams are given tasks and expected to produce results in a given time (no less than two weeks).
- Each member of a team is expected to read, think about, and reflect on a task *before* the team meeting, so that the whole team is prepared for discussing and solving the task through (possible) several meetings.
- After all the solutions are submitted and evaluated by lecturers, one class is organized where the most interesting and provoking solution is presented by the members of the team that submitted it.
- *Not* all of the assignments are performed each year, at each university. Besides personal choice of the professor, technical elements also influence such a decision – for example, assignments 8 and 9 require some specific tools, while some of the other assignments require additional time so they were not appropriate for usage as a part of the crash-course in Tirana.

Results: Novi Sad, informatics

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%			91,67%	82,14%
Average		78,60%	73,15%	79,48%	76,50%	79,04%	91,46%	87,66%	79,64%

2004 – inexperience?

Assignment 2 (FP method) - worst results. Even though it is quite straightforward – a conclusion is made by students, also – it seems that the assignment has enough hidden difficulties, so that it is a regular practice that not many teams reach the maximum number of points.

Assignment 6 (review of a solution of another teams' assignment) does have the highest average, but it represents simply the ability of team members to defend their own opinion, so it is not of a high expertise level.

Results: Novi Sad, informatics

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%			91,67%	82,14%
Average		78,60%	73,15%	79,48%	76,50%	79,04%	91,46%	87,66%	79,64%

Assignment 7 (measuring of the quality of software)- the really highest results. It is straightforward and relatively simple task, where most of the required answers are given by the installed software. Second important moment is that this is the last assignment, given at the end of the semester, when students are pretty much aware of how and what they have to do to solve their task;

Assignment 4 - the highest level of "creative" work – assignment number 4 (creation of use-case and class diagrams) has the second worst results. The main reason for this we consider to be the lack of experience with the real-life work, no practical experience, and possession of scholar knowledge only;

Results: Novi Sad, informatics

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%			91,67%	82,14%
Average		78,60%	73,15%	79,48%	76,50%	79,04%	91,46%	87,66%	79,64%

Assignment 5 – worth noting, but wait! .

Results: Novi Sad, teachers

Novi Sad Professors	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	4	57,50%	50,00%	62,50%	75,00%	65,00%	87,50%	83,33%	67,74%
2005	11	62,00%	54,55%	61,82%	69,05%	72,73%	89,77%	75,00%	68,73%
2006	7	71,43%	44,64%	81,43%	57,14%	52,86%		83,33%	64,29%
2007	15	53,33%	50,83%	72,00%	41,67%			72,73%	58,24%
Average		61,07%	50,01%	69,44%	60,71%	63,53%	88,64%	78,60%	60,95%

Results generally on a lower level, but with respect to assignment distribution comparable with previous

Results: Tirana, master, crash

Tirana	Nr of Students	Average Points Assgn 1	Average Points Assgn 2	Average Points Assgn 5	Average Points Assgn 7	Total Points Assgn
2007	17	78,24%	80,59%	80,00%	98,24%	84,26%

Comparable with NS students:
77,76%, 75,31%, 80,67% and 95,04%.

Better (master level) but not too better (foreign language?)

Results: Skopje, informatics

Skopje	Nr of Students	Average Points Assgn 1	Average Points Assgn 2	Average Points Assgn 3	Average Points Assgn 4	Total Points Assgn
III year	46	46,34%	88,46%	97,14%	51,27%	66,90%
IV year	75	61,44%	96,72%	89,74%	67,94%	76,76%
Average		53,89%	92,59%	93,44%	59,61%	71,83%

-Students of the 4-year studies, gained (except for the 3rd assignment - Review of a product model), much better results than the students of the 3-year studies.

-Assignments 1 (review of requirements specifications) and 4 (Development of a part of a static model) in both groups were much worse solved than the other two assignments (function-point method and Review of a product model).

- We definitely need few more years to be able to compare fully these results with the results of other countries. Namely, as with Novi Sad, for example, it takes at least a year for lecturers to create good criteria for assignments checking. We base this claim on a rather high differences on the averages between students from Macedonia, and

Results: Berlin, informatics

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%

- Percentages for Berlin students show quite a difference between years. From the 2nd, to the 6th assignment, differences are: 9%, 12%, 15%, 16% and 14% approximately. For students from Novi Sad, differences for the same assignments are: 1%, 8%, 4%, 0% and 4%.
- The worst results by far, German students achieved with the 5th assignment (Formal specifications). While both Serbian and Albanian students gained around 80% of points for it, German students had only 74%.
- On the other hand, assignment number 7 (measuring of the quality of software) which was the easiest one for Serbian and Albanian students, and where they both gained 95% or more, in Berlin was not that successful.

Results: Tests

	Test 1	Test 2	Test 3	Test 4	All tests
Novi Sad CS	69,03%	69,14%	62,82%	62,72%	65,93%
Novi Sad Prof	51,52%	55,63%	47,16%	44,98%	49,82%
Tirana	58,33%		50,33%		54,33%
Skopje III year	45,59%	56,70%	54,85%		52,38%
Skopje IV year	59,98%	67,63%	66,60%		64,74%
Average	56,89%	62,28%	56,35%	53,85%	57,44%

-Tirana – lower than expected – distance test or language problems?

Conclusions?

Course	Final mark
NS CS 2004	8,24
NS CS 2005	7,94
NS CS 2006	8,24
NS CS 2007	8,29
NS Prof 2004	6,50
NS Prof 2005	6,00
NS Prof 2006	7,25
NS Prof 2007	6,50
Tirana	8,24
Skopje III year	8,11
Skopje IV year	8,31

Conclusions (contd.)

- No matter what you do the average will be around 8.20 ☺
- Seriously:
  - Student's experience matters – better achievements by 'older' students (SE is such kind of field)
  - Lecturers' experience matters (Novi Sad, Skopje) although we had the same criteria (SE is such kind of field where there is no 'correct solution')
  - Otherwise, problems of SE are universal.