

Teaching Information Systems Technology in Partnership with IT Companies

Poučevanje tehnologije informacijskih sistemov v sodelovanju z računalniškimi podjetji

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Abstract

We describe an example of partnership between university and some major IT companies – IBM and Microsoft – in teaching a course on information systems technology. The course is taught in the fifth (final) year of the university undergraduate program when students have already mastered the basic theoretical knowledge of information systems development. For this reason the course content was restructured in order to pay more attention to practical experience and learning opportunities available within the environment of professional industry. During the course, students get acquainted with IBM and Microsoft products and tools that support the development of Web-based information systems. Special attention is devoted to group project work, which is not only intended for the improvement of technical skills, but also for the acquisition of transferrable skills like teamwork, management/leadership, planning and organizing, presentation and documentation, information search, etc. We describe our experience after teaching the course in the academic years 2005/06 and 2006/07. A description of the course content is given and the results of a survey among students are presented. Students responded favourably to the new approach and found the course very useful and interesting.

Keywords: computer engineering education, university-industry co-operation, group project work, information systems technology

Povzetek

Prispevek opisuje primer sodelovanja med Fakulteto za računalništvo in informatiko in podjetjema IBM in Microsoft pri izvajanju predmeta Tehnologija informacijskih sistemov. Predmet je na programu v petem (zadnjem) letniku univerzitetnega študija, ko študenti že obvladajo temeljna teoretična znanja o razvoju informacijskih sistemov. Zato smo prilagodili njegovo vsebino tako, da je večji poudarek namenjen pridobivanju praktičnih izkušenj v profesionalnem delovnem okolju. V okviru predmeta se študenti seznani z orodji in rešitvami, ki jih za razvoj spletnih informacijskih sistemov ponujata IBM in Microsoft. Posebna pozornost pa je namenjena delu na projektih, katerih namen ni samo poglobljanje tehničnega znanja, ampak tudi pridobivanje sposobnosti za skupinsko delo, vodenje, načrtovanje in organizacijo, pripravo predstavitev in medosebno komuniciranje, iskanje informacij ipd. V prispevku so opisane naše izkušnje s poučevanjem nove vsebine predmeta v študijskih letih 2005/06 in 2006/07. Predstavljena je vsebina predmeta in rezultati ankete, ki smo jo izvedli med študenti. Študenti se strinjajo z novim pristopom in ocenjujejo, da je tako zasnovan predmet zanimiv in koristen.

Ključne besede: izobraževanje inženirjev računalništva, sodelovanje univerze z gospodarstvom, skupinsko delo na projektih, tehnologija informacijskih sistemov

1. Introduction

The interaction between industry and academia is an old concept which, beside the traditional forms of cooperation in development of new products, establishment of joint solutions to industrial problems, provision of training and consultancy, and long-term cooperation in solving research tasks as outlined in Ivanco et al. (1998), offers considerable possibilities for further forms of cooperation in the area of engineering education. While students can learn the theoretical component of their course through lectures, readings, tutorials, laboratory practice, and self-learning activities, the university environment cannot provide the wealth of experience, practical applications, and learning opportunities available within the environment of professional industry. For this reason many tertiary institutions have developed different forms of partnership with industry in the area of engineering education (McKee, W. 1999; Clausen, T., 1998; Neal, L., 1996). Such a partnership can provide a significant educational benefit through the development of a broad range of generic and professionally-oriented skills (Massay et al., 1995; El-Raghi, 1999; Tedford et al., 2007). For some academic institutions senior year students' project work also represents an additional source of income (Clausen and Holta, 2007).

Undergraduate degree programs in Slovenia are often criticized for being too theoretical and not giving students enough practical skills which would enable them a smooth transition from study to a working environment. On the other hand, there is a shortage of experts in specific software products and solutions. Industry also expects engineering graduates to have some grounding in business skills with an increasing emphasis on social skills such as customer relations and team-working. These skills are recognized to be equally important as technical literacy.

In order to alleviate these problems the content of the course Information Systems Technology which is taught in the fifth (final) year of the undergraduate program in Computer Science at the University of Ljubljana was restructured with the aim of introducing organized group project work in partnership with some major IT companies such as IBM and Microsoft. This initiative started in the Academic Year 2005/06 when the first generation of students attended a special course on Web-based information systems development using IBM products. During the course they became acquainted with advanced Java programming, Web technologies (Java Server Faces, IBM Portal Server), and IBM Workplace. At the end they split into groups of 3-4 students and developed a prototype solution of a problem of their own choosing. The solution had to be presented as a business proposal to a panel consisting of technical, financial and business experts (these roles were played by employees of IBM Slovenia and faculty members) which evaluated the proposal from all the aforementioned aspects. In this way, students not only obtained the necessary technical knowledge to develop an information system, but also practiced communication and presentation skills that are needed for successful marketing of the proposed system.

After teaching the course for the first time a survey was performed among students in order to obtain their opinions about the new course content. The majority of students responded favorably to the new approach and found the course very useful. Results of the survey encouraged us to continue with the aforementioned initiative and extend the collaboration to other IT companies.

In the Academic Year 2006/07 the course was taught in partnership with IBM and Microsoft. The overall structure of the course remained the same, but the detailed content was adapted to tools of each vendor that were used during laboratory practice and project work. Consequently, students were offered two different contents: one based on the IBM products and tools and another based on the Microsoft products and tools. Students were allowed to choose the preferred content by themselves and it was interesting that each content was chosen by exactly one half of students. The survey we performed among students at the end of the course showed once again that our decision to run the course in partnership with major IT companies was right.

In the following sections the new course content and the projects that were developed by students in the last two years are described first. Then a detailed analysis of the results of the survey is given and students' opinions about their most positive and most negative experience with the course are presented.

2. Course content

The course lasts 15 weeks (6 hours/week) and consists of three parts: lectures, laboratory practice, and group project work. The course content was designed considering the fact that students obtain a great deal of knowledge of software engineering during the first four years of their studies (viz. software project management, systems analysis and design, information systems development). Therefore, the amount of classical lectures is rather small, while most of the time is devoted to laboratory practice and group project work.

2.1 IBM program

The main purpose of laboratory practice is to expose students to IBM software products and tools that are used later during the group project work. This part of the course is supervised by instructors provided by IBM that are experts in these tools. To deliver the best possible content, IBM standard courseware is used. However, because of the limited time frame, the instructors take only the most important chapters and adapt the contents to the previous knowledge of students. This part of the course is broken down into three major parts, as follows:

1. Java and development tools
 - Java basics, architecture, object model
 - Java advanced topics, Eclipse
 - IBM Rational Application Developer
2. Web technologies
 - Java Server Faces
 - IBM Portal Server
 - Portlet development
3. IBM Workplace

Within the first part the programming language and development environment are introduced. The second part is devoted to Web technologies mostly used in the presentation layer. Finally, the hosting environment of the developed solution is presented in the third part. In the Academic Year 2006/07 a new chapter dealing with the service oriented architecture was added. In this way students are fully empowered for the development of a working solution that can be used as a good prototype for the underlying business problem.

Laboratory practice is followed by the group project which is not only intended for the improvement of technical skills and the broadening of knowledge of software tools used, but also for the acquisition of transferable skills like teamwork, management/leadership, planning and organizing, presentation and communication, information search, etc.

In forming groups, established guidelines are followed concerning group size, task selection, allocation of responsibilities, and assessment of the students' work as proposed by Smith et al. (1996). Group sizes are restricted to four and students are given the opportunity to decide who they should work with. The task and methods are determined by the group, but must be approved by the university professor (the lecturer) and IBM coordinator. The group is asked to nominate a Project Manager who acts as the contact person, and has the responsibility for monitoring progress and coordinating the group. The group is also asked to identify specific roles which they feel will be important in managing the group. Students are also encouraged to work on the project outside the officially scheduled hours. There are two progress meetings (consultations) before the final presentation takes place. Students are also given a short training in order to improve presentation skills.

Due to time limitations the main aim is not to have students develop a perfect working solution, but rather to develop the skill of generating the “big picture”. They must recognize that each computer program has its business implication, audience, benefits, and critical success factors. These are facts that most of young students often tend to forget. The whole content is formed to foster the idea that students develop a working prototype of the complete solution, and develop the logic why this complete solution would benefit the customer.

At the end of the course, the student groups have to present the prototype solution of their business idea to a “business panel” consisting of a university professor (the lecturer) and 2-3 IBM representatives. This group of people plays the role of the board of directors of a potential customer and evaluates the proposed solution from technical, business and user viewpoints. Each group is given 45 minutes to present their idea and the working prototype of their solution. The allotted time must not be exceeded. The presentation usually comprises the following sections: business rationale, technical environment, description of the solution developed, and practical demonstration. During the presentation detailed questions are raised, on the basis of which the group can provide evidence of their knowledge with respect to the problem domain and can justify their design decisions. After the presentation each group receives feedback information about the quality of their project by the individual members of the panel.

2.2 Microsoft program

Microsoft program differs in tools that are used during laboratory practice and group project work. The content of the laboratory practice is based on three standard Microsoft workshops providing students with knowledge and skills to develop applications using Microsoft Visual Studio 2005:

- Core Windows Forms Technologies with Microsoft Visual Studio 2005
- Core Web Application Technologies with Microsoft Visual Studio 2005
- Core Data Access with Microsoft Visual Studio 2005

After passing the exam students are given certificates of attendance that are equivalent to certificates given to participants of regular training courses provided by Microsoft Certified Partners for Learning Solutions.

Project groups are formed using the same rules as within the IBM program. Students are given the freedom to decide who they should work with and which problem they will solve within their project. At the end of the course they present their solutions to a panel of experts consisting of a university professor (the lecturer), a Microsoft university relations person, and a Microsoft Visual Studio 2005 expert. Presentations are attended by all students who are asked to give grades to all projects except their own. Each solution is judged according to criteria of the Microsoft Imagine Cup student contest: 15 % problem definition, 60 % design, 15 % development, and 10 % presentation. The final grade is obtained on the basis of a 60 % contribution of the grade given by the panel of experts and 40 % contribution of the average grade given by students.

Compared to IBM the Microsoft program pays more attention to programming skills and the development of a working solution, while there is less emphasis on the skill of generating the big picture considering the impact of the software solution on all aspects of company's business.

2.3 Overview of the most interesting students' projects

In order to complete the description of the course content we present an overview of the most interesting students' projects.

In the Academic Year 2005/06 the best project was the "Rescue center": a mobile application linking an emergency call center with medical stationary and mobile units. The other projects implemented prototype solutions of the following business ideas:

- Gambling portal: portal for Web-based placement of bets, purchase of lottery tickets, participation in other games of chance, as well as dissemination of information on winnings, and their disbursement.
- Tourist agency: portal for Web-based sale of tourist offerings.
- eMusic: portal for Web-based dissemination of music (selection and downloading of music as well as payment via credit card or mobile phone).
- Knowledge broker: personnel and knowledge management portal (intended for keeping track of training and education schedules as well as searching for needed skills and knowledge).
- Industry tracking system: portal for machine workload assignment, failures tracking, and maintenance planning.
- Enterprise resource planning system: simple Web-based ERP system.
- Finance portal: Web-based stock trading portal.
- Automart: Web-based passenger car sales and service organization (sales and promotion information, scheduling of service appointments, customer relationship management).

In the Academic Year 2006/07 the best IBM project was "My e-House": portal for a company that administers operational costs and maintenance of blocks of flats. The best graded Microsoft project was the "Cars Portal", a Web-based solution for passenger car sales organization. Although the problem itself was not particularly original, the judging panel found the completeness of implementation and technological solutions to be better than in other projects. There were also several other interesting projects:

- Student Coupons: a Web-based system for administering the distribution of student coupons and payments tracking;
- Lodging broker: portal for searching accommodation facilities for students that cannot get rooms in student dormitories;
- Car fleet: car fleet usage and travelling orders tracking in a large company;
- Sports betting: portal for Web-based placement of bets;
- Internet reality show;
- eBooking: hotel reservation system;
- Restaurant management system.

3. Results of the survey

A survey was made at the end of the course in the academic years 2005/06 and 2006/07 with the aim of verifying whether our decision to run the course in partnership with IT companies was right. The results are presented in 5 sections describing a general evaluation of the course, evaluation of the course content, comparison to other courses, students' opinions about the most positive and most negative aspects of the course, and their evaluation of the examination process.

In the Academic Year 2005/06 the course only run in partnership with IBM. The survey was answered by 32 students out of 35, thus representing 88.89 % of the students that attended the course. In the Academic Year 2006/07 48 students attended the course; 24 of them chose the IBM program and 24 the Microsoft program. The survey was answered by 18 students (75 %) that attended the IBM program and 14 students (58.33 %) that attended the Microsoft program¹.

¹ Some respondents did not answer all questions; therefore, the sum of answers in these cases does not equal the sample size.

3.1 General evaluation of the course

The first two questions were intended to obtain a general evaluation of the course.

Question 1: *Do you support the decision to run the course in partnership with a software company?*

	2005/06 IBM	2006/07 IBM	2006/07 Microsoft
a) yes	32	18	14
b) no	0	0	0

Question 2: *How useful is the course?*

	2005/06 IBM	2006/07 IBM	2006/07 Microsoft
a) the course is useful and interesting	21	11	13
b) the course is useful	10	7	1
c) the course is not useful	0	0	0
d) the course is not useful and uninteresting	1	0	0

The answers to both questions are very encouraging. We were pleasantly surprised by the unanimous support of our decision to run the course in partnership with software companies which confirms the hypothesis that students really want to obtain more practical experience during their studies. Most of them also felt that the course was useful and interesting.

3.2 Evaluation of the course content

The aim of the next question was to obtain students' opinions about the amount of each topic taught during the practical part of the course.

Question 3: *How do you rate the amount of each topic presented in the course?*

Answers to this question are presented for each program and each academic year separately in Tables 3.1, 3.2, and 3.3. The results in Table 3.1 show that the decision regarding the amount of each topic presented in the Academic Year 2005/06 when we started the cooperation with IBM was quite good. The majority of students felt that all topics were covered just right. Nevertheless, there were some topics that needed further consideration, viz. Java basics, Java Server Faces, and consultations about students' projects. Time devoted to Java basics could be diminished in order to pay more attention to Java Server Faces and consultations regarding students' projects. Consequently (and considering the fact that students enrolled in the fifth year in the Academic Year 2006/07 learned Java as their first programming language), we decided to omit topics dealing with Java basics and Java development environment and to increase time devoted to Java Server Faces and consultations regarding students' projects. Additionally, a new topic dealing with the service oriented architecture was introduced.

Table 3.2 shows student opinions about the IBM program in the Academic Year 2006/07. Students responded almost unanimously that the amount of the course devoted to the service oriented architecture was just right. A significant improvement can also be noticed regarding their opinions about the amount of the course devoted to Java Server Faces, while there was only a slight improvement regarding consultations about students' projects. On the other hand, the number of students who were not satisfied with the amount of Workplace practice increased unexpectedly.

Student opinions about the amount of each topic taught in the Microsoft program are shown in Table 3.3. The majority of students responded that the topics within the Core Windows Forms Technologies and Core Web Application Technologies workshops were covered just right, while there were more remarks concerning the limited time frame for some topics of the Core Data Access workshop. The content of this workshop was reduced due to the end of semester and some topics were not covered adequately.

Table 3.1. Student opinions about the amount of each topic taught within the IBM program in the Academic Year 2005/06

	Too Little	Just Right	Too Much
Java			
a) Basics, architecture, object model	0	19	13
b) Eclipse development environment	4	22	5
Web technologies			
a) Java Server Faces	13	16	3
b) WebSphere Portal	5	24	3
c) Portlets	4	27	1
Consultations regarding students' projects	11	21	0
Workplace			
a) Workplace infrastructure	4	20	7
b) Workplace practice	4	20	7
c) Workplace and portlets	7	18	5
Consultations at the end of the laboratory practice	8	24	0

Table 3.2. Student opinions about the amount of each topic taught within the IBM program in the Academic Year 2006/07

	Too Little	Just Right	Too Much
Web technologies			
a) Java Server Faces	5	11	2
b) WebSphere Portal	1	17	0
c) Portlets	6	11	1
SOA technologies			
a) Basics, architecture	0	15	3
b) Practice	2	15	1
Consultations regarding students' projects	9	9	0

Workplace			
a) Workplace infrastructure	5	13	0
b) Workplace practice	9	8	1
c) Workplace and portlets	9	8	1
Consultations at the end of the laboratory practice	6	11	1
Group project work	4	13	0

Table 3.3. Student opinions about the amount of each topic taught within the Microsoft program in the Academic Year 2006/07

	Too Little	Just Right	Too Much
Core Windows Forms Technologies with Microsoft Visual Studio 2005			
a) Creating a simple Windows Forms application	0	11	3
b) Configuring standard controls	0	12	2
c) Building menus	0	12	2
d) Displaying and edit data by using data-bound controls	4	10	0
e) Providing user assistance and enhancing usability	0	13	1
f) Creating consistent applications by using dialogs and forms inheritance	1	13	0
g) Adding print and report functionality to a Windows Forms application	3	11	0
h) Performing asynchronous tasks by using the BackgroundWorker component	8	6	0
i) Deploying a Windows Forms application by using ClickOnce	2	11	1
Core Web Application Technologies with Microsoft Visual Studio 2005			
a) Creating a Web application	0	14	0
b) Programming a Web application	1	13	0
c) Adding and configuring server controls	1	13	0
d) Using master pages to establish a common layout	0	13	1
e) Managing state data			
f) Accessing and displaying data	3	11	0
g) Controlling access to a Web application	3	9	2
h) Deploying a Web application	4	10	0
i) Creating a mobile Web application	1	12	1
	3	4	5

Core Data Access with Microsoft Visual Studio 2005			
a) Connecting to databases and reading data			
b) Querying and updating databases by using commands	0	14	0
	0	14	0
c) Performing transactional operations			
d) Performing disconnected operations programmatically	5	9	0
	6	8	0
e) Performing disconnected operations by using Visual Studio 2005 wizards			
f) Performing XML operations on disconnected data	5	7	2
g) Reading and writing XML data			
h) Processing XML data by using the Document Object Model DOM	5	8	1
	6	8	0
	9	4	1
Consultations regarding the group project	1	12	0
Group project work	0	13	0

3.3 Comparison to other courses

We also wanted to know how our course compares to other courses at the faculty. Therefore, we asked students the following question:

Question 4: *How do you rate the course in comparison to other courses in the final year of your study?*

	2005/06 IBM	2006/07 IBM	2006/07 Microsoft
a) better	14	10	14
b) approximately the same	18	8	0
c) worse	0	0	0

The answers to this question also show that the students are satisfied with the course. Most of them, especially those that attended the Microsoft program, feel that the course is better or of approximately the same quality as the other courses in the final year of their study. Nobody rated the course worse than other courses in the same academic year.

3.4 Students' remarks: Pros and Cons

The survey also contained two open ended questions giving students the possibility to describe their most positive and most negative experience with the course.

Question 5: *What did you like most?*

Question 6: *What did you disturb most?*

In their answers to question 5 almost all students pointed out the possibilities to obtain practical experience working in partnership with one of the leading IT companies. They liked the course because it gave them the opportunity to get acquainted with modern software development tools and technologies and solve practical problems in an almost-real business environment.

Students that chose the IBM program also liked the course because they improved their presentation skills by having the possibility to present their own projects and receive extensive comments about the quality of the presentation, and obtained experience not only from the viewpoint of development, but also from the viewpoint of selling software solutions. Students that chose the Microsoft program praised most the quality of laboratory practice supervised by instructors provided by Microsoft.

The analysis of answers to question 6 has shown that the students were mostly annoyed by some organizational issues. In the Academic Year 2005/06 some presentations of students' projects were delayed or postponed due to other engagements of the panel members. Consequently, in the Academic Year 2006/07 a special attention was devoted to this problem and all presentations were carried out according to schedule in two days. Additionally, some students that attended the IBM program felt that during the presentation of their projects there was too much attention devoted to presentation skills and business aspects while the technical solution was underestimated. A few of them also complained that the equipment they had at their disposal was not powerful enough to run the software tools they used during the development of their projects efficiently.

Students that attended the Microsoft program were mostly annoyed by the fact that lectures and laboratory practice took place on Friday afternoon. There were also some individual remarks that the amount of material covered was too large for a limited time frame they had at their disposal. Similarly, some students felt that they did not have enough time to complete their projects.

3.5 Objectivity of grades

During the students' presentations, all projects were graded using the same (rather rigorous) evaluation criteria, but at the end all grades were normalized relative to the best project. The best project was given the highest possible grade, while the grades of other projects were appropriately adjusted. Considering the fact that the final grade was not obtained through classical examination, but depended mainly on the student's project and its presentation we wanted to obtain students' opinions about the objectivity of grades.

Question 7: *Estimate the objectivity of examination using grades from 1 (insufficient) to 5 (excellent)?*

a) IBM program in the Academic Year 2005/06	4,22
b) IBM program in the Academic Year 2006/07	4,72
c) Microsoft program in the Academic Year 2006/07	4,57

The answers to this question also show that students were satisfied with the course. They graded the objectivity of examination as very satisfactory and considered the grades they obtained to be fair and correct.

4. Conclusions

We presented an example of co-operation between the Faculty of Computer and Information Science of the University of Ljubljana and Slovenian branches of IBM and Microsoft in the area of computer engineering education. Our experience has shown that courses that are run in partnership between university and major IT companies can provide students with additional special knowledge that cannot be obtained through classical lectures at the university. Students are faced with almost-real problems that must be solved and presented to potential customers. They can do it using the newest tools and technologies, but they must be aware of the fact that it is not enough that the solution is technically perfect. It must also be economically justified and well presented.

Results of the survey among students have shown that students fully support such an approach. All of them agree with the decision that the Information Systems Technology course is run in partnership with major IT companies. Most of them also feel that such a course is interesting and useful, and for this reason better than other courses.

On the other hand, we must conclude that (at the moment) such a partnership is more a result of some individual efforts than a consequence of a systematic approach at the university level or within the educational system at all. In spite of declarative support there are no practical solutions that would enable experts from industry to participate in certain phases of the educational process. Beside, courses that require involvement of people from industry and group project work require much more coordination than classical courses taught completely at the university.

Regardless of aforementioned problems we believe that such courses must become an important part of information systems and software engineering curricula and should be considered seriously when new curricula (compatible with the Bologna Declaration) are prepared. We will also try to do our best to start similar initiatives with other IT companies in Slovenia.

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