New Perspectives on Teaching Computer Science in Europe

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NEW PERSPECTIVES ON TEACHING COMPUTER SCIENCE IN EUROPE

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Abstract

In this paper we describe our joint project, under the European Union's Curriculum Development at Initial/Intermediate level (CDI) initiative, to establish a collaborative Masters level course in Computer Science.
The project is proposed by five European institutions: Instituto Superior de Engenharia de Coimbra (Portugal), Hochschule fur Angewandte Wissenschaften Hamburg (Germany), University of Huddersfield (England), Université François Rabelais Tours-Blois (France) and Turku Polytechnic (Finland). This project aims to create a harmonized computer science course between the participating institutions, where the students must study in three different countries, using three different languages, without extending the number of study years. We discuss the philosophy and aims of the project and some implementation details. Each of the participating institutions/countries has its own traditions and management structures, and we describe the problems that arose in coordinating these and the solutions and compromises that we reached.

1. Introduction

International collaboration in Computer Science education is becoming more and more widespread. Very often this will simply take the form of student and/or teacher exchanges (e.g. under the EU's ERASMUS and SOCRATES [2, 3] initiatives). More extensive collaborations most commonly take the form of an "unequal" partnership, in which one or more institutions are franchised to shadow courses at the leading institution. Truly equal partnerships are less common, and mostly seem to take the form of bilateral agreements.

In this paper we describe the development of an international collaborative Master's level course in *European Computer Science* (hereafter called ECS), involving five institutions in five member states of the EU; Instituto Superior de Engenharia de Coimbra (Coimbra – Portugal), Hochschule für Angewandte Wissenschaften Hamburg (Hamburg –

Germany), University of Huddersfield (Huddersfield – England), Université François Rabelais (Blois – France) and Turku Polytechnic (Turku – Finland).

2. The European Computer Science Project

2.1. Aims

The ECS is a 4-year Masters level course in Computer Science, harmonized across the participating institutions. The focus of the course is on providing the knowledge and skills required by a computing professional who will be working within a multilingual European context, supplemented by deeper specialist knowledge of particular fields chosen by the student.

Each institution provides an agreed core curriculum as part of the first two years of the course. This common core has been designed to facilitate the movement of students between institutions, and includes also foreign languages and a module about the European context of Information Technology. In the final two years students are able to take advantage of the different specializations available in each institution as well as enhancing their core computing skills.

Students study for two years at their home institution, and for one year at each of two of the partner institutions, studying in their native language and two foreign languages. The course includes a six month industrial placement and a final project.

The course aims also to develop a deeper understanding of the cultural differences and similarities between the regions of Europe, and to develop the ability to communicate effectively in at least three modern European languages.

Upon successful completion of the course the students will get a triple award consisting of the degrees of the three institutions at which they studied. These degrees are: *Ingénieur Maître* (**Blois**), *Licenciatura* (**Coimbra**), *Diplom-Informatiker [FH]* (**Hamburg**), *Master of Engineering* (**Huddersfield**) and *Insinööri [AMK]* (**Turku**).

2.2. Development

There were three major stages in the development of this project. Firstly we had to coordinate our curricula, as far as possible, since students may spend any two of their last three years at partner institutions. It was clear from the start that most partners would not be able to establish totally new courses. Our aim was always to use existing modules as far as possible.

Secondly we had to design a co-operation agreement laying out the rights and duties of the partners, to be signed by all the institutions. The main aim in designing the co-operation agreement was to arrive at a document that would guarantee the continuity of the course, and equality of costs and benefits for each institution, while providing as much flexibility as possible.

Finally, we had to gain official approval for the new course from each of the participating institutions. The process was complicated by the differing traditions in each institution not only for the approval of new courses, but also in quality assurance mechanisms. The core curriculum and co-operation agreement were designed to satisfy the most stringent of the institutions that the new course had the quality assurance mechanisms in place that were needed to satisfy their requirements.

2.3. Language teaching

The language component is an essential part of the course. The language skills of the students when they start the course vary significantly from country to country. We had to arrive at a formulation that would guarantee the language component while taking into account this variation in prior knowledge.

2.4. Degrees

We wanted to make an award recognizing the international nature of the course. The choice was a triple award corresponding to the degrees of the institutions where the student studies.

2.5. Costs and Fees

At least at one of the institutions students are expected to make a personal contribution to tuition fees. This could clearly make such an institution a less attractive option for some visiting students. For this reason we decided that students would, for accounting purposes, at all times be considered to be students of their home institution. However, the funding of the institutions is dependant on student numbers so a balanced exchange of students must be guaranteed.

3. Implementation status

3.1. Blois

The *Institut Universitaire Professionnalisé* (IUP), option *Informatique et Télécommunication* is a department of the *Faculté des Sciences*. The IUP courses were created in 1995 to replace the *Maîtrise de Sciences et Techniques*. The IUP offers a three year course for students who have successfully completed one year of post *baccalauréat* education. The syllabus includes a six month industrial placement, training in professional issues, and two foreign languages (English, and German or Spanish).
The degrees offered are the *Licence IUP*, the *Maîtrise IUP*, and, for the best students, the *Ingénieur Maître*. The department also offers the *Diplôme d'Etudes Spécialisées* (DESS), a masters level degree in Information Systems and Networks. The department has 9 academic staff and approximately 20 part-time lecturers from industry. The department has strong links with industry, particularly France-Telecom and AtosOrigin.
We only faced one local problem - our IUP courses are three year courses, rather than the four year course envisaged for the ECS. This was, however, not a major problem. The three year curriculum already provided the ECS core curriculum, and the *Maîtrise IUP* and DESS offered a sufficient range of specialisation options. Foreign students visiting Blois may have to choose a mixture of modules from various years of the *Maîtrise*, while Blois students must make a careful choice of modules studied at partner institutions.
We have now completed the validation process and the President of the University has now signed the co-operation agreement.

3.2. Coimbra

The *Instituto Superior de Engenharia de Coimbra (ISEC)* opened as a college of higher education in January 1975. Originally ISEC offered four-year courses in Electrical, Mechanical and Industrial Chemical Engineering. With the integration of ISEC into the

Portuguese polytechnic system the length of the courses was reduced to three years, leading to the *Bacharelato* degree. In 1999 a second specialised academic degree, the *Licenciatura*, was introduced consisting of two further years study following the *Bacharelato*. The Department of Informatics and Systems Engineering (DEIS) offers a *Licenciatura* in Informatics and Systems Engineering, including a 6-month period of industrial placement. The department has many contacts with IT companies, which greatly facilitates the industrial placement process. DEIS has about 45 academic staff and around 600 students.

The main problems encountered in Coimbra was that at the time that we were developing this course Coimbra could not offer either any language teaching or appropriate specialisations for the ECS. However, ISEC and DEIS have been very co-operative in helping to guarantee our implementation of the ECS. One specialisation was submitted to, and approved by DEIS at this pilot stage.

Satisfying the Ministry of Higher Education has proved more difficult: the Ministry did not approve our first submission. A second submission was made in January 2003 and we are making a maximum effort to get an approval to start a pilot project. We are still very actively involved in the further development of ECS, and we are exchanging students with our partners on a bilateral basis.

3.3. Hamburg

The history of *Hochschule für Angewandte Wissenschaften Hamburg* dates back to 1749. It became the *Fachhochschule Hamburg* in 1970, and was given the alternative name of Hamburg University of Applied Sciences in 2001. The Department of Electrical Engineering and Computer Science offers a wide range of courses leading to Diplom (FH), Bachelors and Masters Degrees. The department has 2000 students and almost 150 academic staff.

Hamburg has been the central co-ordinator of this project from its inception. Colleagues in the department are co-ordinating the development of a similar course in Electrical Engineering. The ERASMUS funding of their project started two years before our project, and our group have greatly benefited from their experience. Also, many of the necessary changes - e.g. triple degrees, provision of language teaching, the ECTS - had already completed the validation process.

When we started developing the course we were just implementing totally restructured Diplom (FH) courses in "Technical Computer Science" and "Software Techniques" which supported most of the ideas in the ECS, including the specialisation phase. However, Hamburg has since moved to a Bachelors/Masters structure and we now have to map the 4-year ECS onto a 3+2-year Bachelors/Masters structure. The core curriculum could still be taken from the Bachelors phase, but we have had to create the specializations from a combination of third year Bachelors modules and first year Masters module. This has created a new problem. The Masters course at Hamburg was planned with a maximum capacity of 30 students. Since we are hoping to recruit 30 students to the ECS, the ECS would have no available places left for other students in the first year, and there would have been no students progressing to the second year of the Masters. We have only been able to solve this problem by restricting our intake on the ECS to 15 students, and expanding the capacity of the first year of the Masters to 35

students. We now have a shortfall of 15 ECS places, and we need to find a new German-speaking partner to make up this shortage.

3.4.   Huddersfield

The *University of Huddersfield* has existed as an institute since the 1840s. It became a Polytechnic in 1970 and was granted University status in 1992. The School of Computing and Engineering has around 100 academic staff and 2300 students. The school offers a wide range of courses at Diploma, Bachelors and Masters Level.

In common with most UK universities the University of Huddersfield has a fairly stringent procedure for quality assurance, partly imposed by central government, requiring a large amount of documentation. Two categories of documentation can be distinguished - internal documentation (e.g. specifications of modules delivered at Huddersfield) and partnership wide documentation (e.g descriptions of quality assurance mechanisms). The relevance of the second class to the other institutions is clear. However, the internal Huddersfield documentation also proved useful in helping us to consolidate our understanding of the overall structure of the course.

A second problem at the University of Huddersfield was the language component of the course. Students' language skills in the UK are weaker than in any of the other participating countries. We are addressing this by targeting modern language departments at secondary schools in our search for potential students, as well as our more traditional sources.

Problems were also created when the University of Huddersfield moved from a semester-based system of delivery (modules may be delivered over either one or two semesters) to a term-based system (modules should last for a complete academic year). The change to term-based delivery made the inclusion of industrial work experience in the course more difficult. Originally we had intended the students to spend one semester of the third year in work experience, with the other semester dedicated full time to academic subjects. The only alternative was to arrange the work experience throughout the year on a part-time basis. We are investigating the possibility of ``industry-based training'', possibly with the student carrying out work at the University rather than at the company, under the supervision of an academic member of staff. The School of Computing and Engineering is fortunate in having a nationally recognised Placement Unit with many years' experience in finding and supervising industrial placements, and with well-tested mechanisms for ensuring the quality of students' industrial experience.

The University of Huddersfield has now given formal approval to the course, and the Vice-Chancellor has signed the co-operation agreement.

3.5.   Turku

Education in engineering sciences in Turku dates back to 1849, when the Industrial School started operation. Over the decades the range of subjects offered has diversified through growth and mergers. Today *Turku Polytechnic* is the largest polytechnic in Finland with 10,000 students.

Perhaps due to this strong historical tradition in engineering sciences our curriculum for CS students has been based on concepts of analogue physical systems. Our CS students have shared their first semester with EE students studying subjects such as physics, electromagnetics and basic circuit theory. It has not been possible to fit more than a few

introductory courses in CS into the first two years' of study. During this ECS project we started separating our EE and CS degree programs. Our new CS degree program is now directly based on the ECS group's core studies structure.

Another problem in the development of the ECS stems from the Finnish educational system. We have adopted the German two-path model (Universität/Fachhochschule), which means that we cannot legally award Masters Degrees, which is a university degree by definition. We award a four-year *Insinööri (AMK)* degree which is officially recognised as being equivalent to a BSc. This problem was solved by multilateral acceptance within our ECS group, and ECS-graduates will be awarded the *Insinööri (AMK)*.

4. Conclusions

We have designed a multinational, multi-institutional Masters level course in Computer Science. In doing so we have gained valuable insights into the differing traditions and mechanisms of the tertiary education systems of different European countries.

Students will benefit from this course, over and above the normal benefits of a Software Engineering course by developing fluency in two foreign languages, both in everyday use and specialist terminology; and by gaining a better understanding of two other European cultures, as a consequence of the years spent in those cultures. The course is now running.

4.1. The Future

We hope to extend the co-operation to include new partners, both from countries already represented and from other European countries. One possibility under consideration is the creation of geographical sub-networks. For example, a Northern/Baltic network, a Southern/Mediterranean network and an Eastern network. These sub-networks may offer other language combinations than the English/French/German combination envisaged for our network. The sub-networks would also be linked to provide a larger selection of languages for participants. We are currently considering the changes that may need to be made to the agreements to accommodate a larger number of languages.

We would be pleased to hear from any institutions interested in joining our partnership, and such institutions are invited to contact any of the authors.

5. ECS Project Team

This curriculum development and implementation activity has been done by the following team:

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6. Acknowledgements

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