The European Computer Science Project: An Experience Report

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Abstract

The European Computer Science course is a joint project under the European Union's Curriculum Development at Initial/Intermediate level initiative. The main goal is to create a harmonized computer science course between the participating institutions, in which the students must study in three different countries, using three different languages, without extending the number of study years. This paper reports the main goals of the project, the current status, coordination activities to solve the problems faced during the past two years and future developments.

1 Introduction

The European Union and the end of boundaries between the member states brought a lot of opportunities for the European citizens but also new challenges concerning the educational system organization. It is important to go beyond barriers, such as the foreign languages, cultural issues, and the different curricula structures and profiles of the courses. To a certain extent, the Universities in Europe still do not fully prepare the students to face those new challenges. In order to minimize these problems, in June 1999, several countries signed the Declaration of Bologna [1] having in mind the possibility of creating the European space for higher education. In the same context, a group of five institutions decided to create a truly European course, the European Computer Science (ECS).

The ECS is a 4-year Masters level course in Computer Science, harmonized across five institutions in five countries of the European Union:

- Higher Institute of Engineering of Coimbra (Coimbra – Portugal);
- Turku Polytechnic (Turku – Finland);
- University of Applied Sciences Hamburg (Hamburg – Germany);
- University François Rabelais of Tours (campus of Blois – France);
- University of Huddersfield (Huddersfield – England).

The course aims to provide the knowledge and skills required by computer science graduates who will be working within a multilingual European context, supplemented by various specialization fields chosen by students [2-5]. 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, thus studying in their native language and two foreign languages. The course includes a six month industrial placement and a final project. It aims also to develop a deeper understanding of the cultural differences and similarities between the regions of

Europe, as well as to develop the ability to communicate effectively in at least three 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).

This paper is organized in four chapters. The next Chapter presents the course structure and development stages. A special emphasis is given to the current activities regarding convergence of learning and teaching. Chapter 3 presents the current implementation status in the five institutions. Finally, conclusions and future perspectives will be given in Chapter 4.

2 The ECS Structure and Development

The course developed within the scope of the ECS project is a CDI project (Curriculum Development at Initial/Intermediate level) part of the Socrates-Erasmus Program of the European Union. A CDI project intends to implement graduated courses in Europe with a minimum of three institutions, thereby promoting the cooperation and developing well structured and harmonized programs. The main goals of this project are:

- Define and run a European course in the Computer Science field;
- Harmonize the course structure in all the participating institutions of the project;
- Ensure that each student will study in three European universities and in three different countries;
- Encourage the study of foreign languages and European culture;
- Offer a wide range of specializations in every institution;
- Supply graduates in computer science with knowledge and skills required to work in the European space.

This group of cooperating institutions has successfully developed a European Computer Science (ECS) course. Over 4 years, students study in 3 countries in 3 languages. To achieve this, the partners identified and implemented a common core curriculum and a set of specializations. The core is delivered mainly in the first two years, and each institution offers their own specialized parts of the curriculum in years 3 and 4.

2.1 Curriculum Organization

The course is organized by semesters and has duration of 4 years. It is divided in two main components. The core component, in the first two years, will be taught optionally at the student's home institution and it should:

- guarantee the base skills within the several areas of Computer Science and Mathematics;
- allow students to be fluent in at least two foreign languages;
- allow students to be familiar with historical and cultural issues of the five countries involved in this project.

The specialization component has to be done in two different host institutions, in two different subjects and in two different languages; therefore, each institution must propose a specialization curriculum to the foreign students. Furthermore, in the third year, students will have a practical work in industry, and in the fourth year students will have a final project at the host university.

2.2 Development Stages

There were four major stages in the development of this project.

- Curricula coordination: Since students may spend any two of their last three years at partner institutions, the core modules contents should be the same or very similar. It was clear from the start that most partners would not be able to set up a totally new course in their institutions. Therefore, the aim was to use the existing modules as much as possible;
- Cooperation agreement: A cooperation agreement was signed, laying out the rights and duties of each partner. The main aim in designing the cooperation agreement was to achieve 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;
- Course approval: The new courses have been officially approved from each of the participating institutions. The process was complex because of different traditions in each institution, in particular for new courses approval and in quality assurance mechanisms. The core curriculum and cooperation agreement were designed to satisfy the strictest rules of all the institutions.
- Convergence of learning and teaching: In the current stage, mechanisms for convergence of learning and teaching are being put into practice. At the same time, mechanisms for course evaluation were implemented in particular questionnaires for students and teachers. Coimbra has also delivered a report describing the course current status to the Ministry of Science and Education.

2.3 Language teaching

The language component is an essential part of the course once the students are obliged to study in three languages (two foreign languages) and to be familiar with 3 cultures. Each member of the ECS is supposed to offer language classes at least in two of the three official languages (until now only English, German and French).

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 ensure the language component while taking into account this variation in prior knowledge. In order to define language competence, goals, assessment and certification we took as a working instrument the Common European Framework of Reference for Languages [6]: learning, teaching and assessment, a document of the Council of Europe. The CFR is a comprehensive, transparent and coherent frame of reference which provides objective criteria for describing language proficiency and aids comparison in order to facilitate the mutual recognition of qualifications gained in different learning contexts, and aids European mobility.

In reference to its scale of descriptors it was decided that a student has got to reach the level B2 in order to study in this language.

2.4 Financial Support

COLT is a project that has been approved and is being financed by the SOCRATES programme. One of its objectives is to develop a joint computer science course which is convergent in learning and teaching methods as well as in curriculum content. The contractual period for this project started on the 1st of September, 2004 and is 36 months long. It supports staff costs (coordination activities of the members) and travel/subsistence for meetings attendance.

By now financial support for student mobility is limited to the Erasmus and Leonardo programs.

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

2.5 Convergence of Learning and Teaching

The work to date has concentrated on convergence in curriculum content and course structure. As well as compatibility in curriculum content, students need appropriate socio-technical support to prepare and enable them to study successfully in 2 foreign countries. Our group has partly addressed this through provisions for language teaching, the development of a module which addresses cultural differences and via standard teacher exchanges. In making these provisions, we have identified significant differences in learning and teaching methods, which can be a barrier to successful mobility. We have also identified the need for cross border forums for teachers to share good practice and for students to build up a sense of course identity with their fellow students abroad.

It is also desirable to extend the benefits of the cooperation beyond the ECS students to students on single programmes. For these students, studying abroad is faced as a higher challenge. A combination of forums with teacher exchanges, if well coordinated, can be used to introduce students to a wider range of specialist computer topics and to promote mobility.

Within this context, the main activities will be:

- to compare learning outcomes, study skills and teaching methods and identify paired curriculum components/teaching methods which should be transferred and trialed in each institution;
- to identify socio-technical requirements for successful student and teacher mobility, develop a regulated and coordinated three year plan for teacher exchanges in order to trial the curriculum component/teaching method pairs and to develop the socio-technical infrastructure;
- to start implementation of the plan, test the infrastructure and evaluate the impact of this approach.

The expected outputs are reusable matrices for relating learning outcomes, questionnaires to assess students study skills and methods, curriculum contents and teaching methods in computer science, a coordinated plan for teacher exchanges which contribute measurably to curriculum convergence and an infrastructure which promotes and supports student exchanges.

3 Implementation Status

In this chapter the current status of ECS implementation is described for every partner as well as a short description for every home institution.

3.1 Blois

The Professional University Institute in Computer Science of Blois (IUP Blois) is a department of the Université François-Rabelais of Tours, located 60 kilometers away. The IUP offers a 3 year Bachelor course and a 2 year Master course in Computer Science. In the local implementation of the Bologna scheme, the Bachelor program corresponds to a

progressive specialization. The first year offers general studies in Mathematics, Physics, Chemistry and Computer Science. The second year focuses on Mathematics and Computer Sciences, and finally the third year concentrates on Computer Science. Then, the 2 year Master course in Computer Science concentrates on two main domains: Networking and Information Systems. All courses have 30 ECTS per semester.
Unlike the other participants to the ECS project, the European course has not started yet in Blois for the following reasons:

- Until September 2005, the first two years of the European Course had no correspondence in Blois, since the first two years of the Bachelor in Computer Science existed only in Tours.
- No foreign students have applied to the European Course in Blois for the moment. Nevertheless, some students have confirmed their intention to do their ECS specialization in Blois in 2006.

Our regular programs merge theoretical studies and technical courses. This is another peculiarity by comparison to some other ECS participants and to French Technical Institutes (IUT) as well. As a result, the local implementation of the European Course in Computer Science has required sensible adaptations of our regular program:

- The modules of ECS year 1 and year 2 are taken from year 1, year 2 and year 3 of the Bachelor in Computer Science. This implies that a French ECS student leaving at the end of year 2 will have to complete the first 2 years of the Bachelor, as well as some modules of year 3.
- The specialization offered in Blois for ECS year 3 and year 4 is Knowledge Discovery in Databases. It is in the area of Information Systems, as the majority of the academic teaching staff is specialist in this area. The majority of the modules of ECS year 3 are taken from the second year of the master.

Since no foreign students have attended the local ECS program yet, we do not have any feedback on foreign language education. Foreign language courses other than English are the only ECS lectures that do not correspond systematically to a regular course of our IUP. We will provide these lectures by using the elective modules available in our regular course. Moreover, in order to help foreign ECS students during their year in Blois, we plan to provide lecture materials written in English, while the lectures will still be given in spoken French. We are also asking our University to provide French language courses in Blois.

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 3 years leading to the *Bacharelato* Degree. In 1999 a second specialized academic degree, the *Licenciatura*, was introduced consisting of 2 further years of study following the *Bacharelato*. The Department of Informatics and Systems Engineering (DEIS) offers a five year degree in Informatics and Systems Engineering that includes 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 700 students.

The main aspects of ECS in Coimbra [7] are described in this section. This includes the actual status, some changes made to the initial proposal and some initially defined goals that have not been totally fulfilled.

For the first two years of ECS in Coimbra the only new created courses are English language, German language, French language and the European Module. The other courses are part of the already existing *Licenciatura* in Informatics and Systems Engineering (5 years) and their contents were adjusted in order to be in accordance to the defined ECS core.

The Department of Informatics and Systems Engineering offers for years 3 and 4 a specialization in Artificial Intelligence and Databases. In the Department many teachers are senior researchers in these areas.

3.2.1 Applications

Table 31 shows the scheduled number of vacancies for new students (first year) for the first three years of ECS in Coimbra, the total number of applicants, and the effective number of enrolled students.

Year	Vacancies	Applications	Enrolled students
2003/04	5	33	5
2004/05	10	32	5
2005/06	15	-	-

Table 3-1 Vacancies, applications and enrolled students

Three of the five students enrolled in 2003/04 passed into the second year of ECS. So currently we have three second year students and five first year students.

These numbers clearly show that the initial goal for the number of effectively enrolled students has not been reached. We can conclude that making ECS, an innovative type of degree, well-known by really interested students is one of our main challenges. In this field marketing activities are part of the main tools. Messages to mailing lists, school visits and print media advertisements have been used.

3.2.2 Student profile

In order to achieve the defined goals for success and quality, we have implemented regular meetings between ECS students and the Coimbra ECS Coordination team. Every problem and difficulty have been analyzed and solutions were proposed. The level of motivation of the students was also assessed.

Portfolios and questionnaires have also been used to supervise and define the profile of our students, and to have some valuable feedback to enable short term fixing of any problem.

From the questionnaires we can conclude that students consider that:

- they have a good knowledge of English, regular of French and poor of German;
- ECS is demanding;
- the assessment process is adequate for every course in Coimbra;
- they are globally satisfied with the Department of Informatics and Systems Engineering.

From the portfolio, that consists of three parts (student characterization, evaluation of every course and teacher self-evaluation), it can be concluded that most of the students:

- would like to specialize in Artificial Intelligence;
- are expecting financial support exclusively from their parents;
- expect to work abroad after they finish their studies;

- expect to easily find an interesting well paid job.

3.2.3 Year transition and assessment

Initially it was defined that students in Coimbra:

- couldn't move to the second year before completing every course of the first year;
- should be excluded from ECS and could apply to the *Licenciatura* in *Engenharia Informática e de Sistemas* (LEIS) after failing twice any course.

These rules were considered to be too restrictive and unreasonable for the kind of effectively enrolled students. So students can now move to the second year even if they have uncompleted courses from the first one, and they also have more chances to complete any course.

3.2.4 Assiduity

Assiduity is considered to be one of the keys for success and the ECS team continuously reminds the ECS students of this important detail. To evaluate assiduity, teachers have been asked to register the attendance of every ECS student. Obtained results show that despite all the strong and repeated recommendations, assiduity has shown to be very low. This can be identified as one of the main contributing factors for low academic success until now. It should be pointed out, however, that this problem is not exclusive to the ECS students.

3.2.5 Foreign languages

The aim of language teaching at ISEC is to contribute to the personal and cultural development of the students as responsible European citizens in a plurilinguistic democratic society. The learner does not simply acquire knowledge in two distinct languages, but becomes plurilingual and develops intercultural awareness, skills and know-how. These aspects are also enriched in the European Module of the ECS course.

Students in Coimbra can choose to learn any two of the three official languages defined by ECS, i.e., English, German and French. All language teachers are native language speakers and meet regularly to exchange experiences and to define goals. The evaluation of the language skills is not only performed by ISEC teachers, but also by external exams officially

Currently students from the second year are studying English and French (after the first year they gave up German) and those from the first year are taking English and German. None of the students had any knowledge of German before starting ECS studies.

We can conclude from the assessments that students have a regular knowledge of English and a basic knowledge of German and French. These levels are below those required by the initial proposal to go abroad in the third and fourth year. Language teaching therefore, must be intensified at ISEC, since very often students do not have the chance to learn the languages they are interested in at the grammar school due to the curricular structure. Given this stance, no one should obviously be excluded from taking ECS for this reason, thus students are given the opportunity to learn a new language from beginning levels.

3.2.6 Bologna

In Coimbra, ECS transition to the Bachelor/Master structure defined by the Bologna Declaration is to be made in a short term along with the five year degree in Informatics and Systems Engineering to avoid all kinds of difficulties related to the creation of too many ECS specific courses.

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.

The European Computer Science course started in the Department of Computer Science of Hamburg University of Applied Sciences (HAW) in the year 2003 with one student. In 2004 nine students applied for the course; from these 9 students 6 passed into the 2nd semester.

The HAW's Computer Science Department offers a 3 year Bachelor course in Technical Computer Science, a 3 year course in Applied Computer Science and a 2 year Master course in Distributed Systems. The 4 year ECS course is a kind of virtual course. Its lectures in the first 2 years are taken from the Technical Computer Science course, enriched by ECS specific components like language education and the European module. The 2 specializations for the years 3 and 4 offered in Hamburg are Technical Computer Science and Distributed Systems. It can easily be seen that its lectures are taken from the other regular courses, too. The course has 30 ECTS per semester.

Though the language education with 5 European Credit Transfer Points (ECTS) is 1/6 of the regular student's workload, students tend to reduce their efforts there if they have problems in other lectures like programming. The reason is that they follow the Computer Science lectures together with the other students, but are the only ones who have the language courses.

The language school preparation of the students, especially in French, was very different; some students were beginners, some reached the A1 level and some A2 in the entry language classification. So, we introduced a successful visit of a 4 year school course in French as a general prerequisite.

ECS is the only 4 year Computer Science diploma course at HAW Hamburg, the other courses are 3 year Bachelor courses and the 2 year Master course as mentioned above. This makes it difficult to offer the specializations. It is declared intention of the German government to follow the Bologna declaration and change the Diploma courses to a Bachelor/Master structure. This must be noticed when discussing the future development of ECS. From our point of view, we have to change our ECS course to a 3+2 structure, too.

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. Two ECS students started this year.
Top-up fees will be introduced at the University of Huddersfield from September 2006. The maximum of £3000 will be charged, however this does not apply to ECS/Erasmus exchanges.

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.
The Ministry of Education has prepared a proposal for Master degrees in Polytechnics. Bachelor degree is 240 ECTS and Master is 300 ECTS. In order to join a Master course,

students must have 3 years of work experience. It is very likely that this proposal will be accepted and legislated later this spring. Inside the Bachelor degree, the current industrial placement of 1 year will be organized in semesters and will take 4 months.
The number of ECS students will be known at the end of this year, since there are no separate applications for the ECS course.

4 Conclusions

Trans-national courses are each time more important in the broad European space. This kind of courses should be implemented in spite of all the difficulties.

ECS students should have higher levels of responsibility, commitment and determination than students of regular courses to complete their studies with success. The required student profile can partially explain why Coimbra ECS students have been experiencing some difficulties.

The student supervision implemented in Coimbra should be continued in order to solve eventual problems and to get an accurate vision of ECS evolution.

In order to fulfill the difficulties that have been detected since the course started the following activities are being discussed:

- adaptation of the ECS curriculum to the Bachelor/Master Bologna structure;
- new partners in order to increase the potential number candidates for the specialization offered by DEIS;
- new foreign languages should be added, including Portuguese and Spanish, to improve mobility and to increase the number of potential candidates;
- increase of divulgation through advertisements in local and national media and participation in national and international conferences;
- convergence of teaching methods and curriculum structures, namely through teacher and student mobility for effective experience exchanges.

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