

## **Preparing Students for Globalization – Working with International Teams with Projects**

**A. Friesel**

*Electronics and Electrical Power Sections, Copenhagen University College of Engineering, Lautrupvang 15, DK-2750 Ballerup, Denmark, phone: +45 4480 5189, e-mail: afr@ihk.dk*

### **Introduction**

Copenhagen University College of Engineering in Denmark has signed cooperation agreements with many technical universities and colleges all over the world. Most of the agreements are within the different programmes which contain a wide range of measures designed to support the European activities of higher education institutions and to promote the mobility and exchange of their teaching staff and students. The SOCRATES-ERASMUS programme was established in 1987. At the Copenhagen University College of Engineering we are well prepared to receive international students [1], because we have several programmes taught in English. In the Department of Electronics and Computer Engineering (EIT) we offer full bachelor programs in Electronics and in Information and Communication Technology, both taught in English. We also receive students from many other countries outside Europe on these two programmes. Most of our courses use educational methods based on teamwork and project-based learning. The ability to work in teams and with projects involving international students may differ a lot depending on the educational traditions of the students' homelands. The goal of most undergraduates studying engineering courses, whether traditional or of a more modern structure is to work in an engineering company and most likely in their home country. However, few undergraduates gain entrepreneurial skills during their studies or experience working in teams with students from other countries. And yet, in their intended employment, global market conditions almost inevitably place graduate engineers in just this situation – working on projects, in teams, often international and sometimes working in different geographical locations. Engineers of the future must be able to operate in a team-based, multidisciplinary world where communication and skills are very important [2, 3].

The Bologna Declaration [4] of 1999 seeks to address these issues through the development of a common European Higher Education Area (EHEA), where increasing student mobility is just one of the many goals

[5]. Numerous authors have promoted working on projects in teams for decades and many universities have adopted project working into their programmes using a wide variety of approaches. This direct experiential learning is the key feature in Project Based Learning for engineering students. Learning to communicate across cultures through membership of an international team significantly contributes to better technical achievements [1].

### **Description of the robot project**

The robot project is fourth semester project at the Department of Electronics (EIT). It is the interdisciplinary project combining the theory and practical design of small autonomous robots [6] in two courses, REG4E and PROE4. Both courses are included in mandatory part of the undergraduate program for engineering students leading to the degree of Bachelor of Engineering in Electronics. The theoretical part of REG4E course includes mathematical modelling, system dynamics, control theory, digital and analogue electronics, and microprocessors. The practical project (PROE4) is to design an autonomous robot performing two tasks: a compulsory task decided by the teachers and a free task decided by students. The team consists of 3-5 students and there is appointed a supervisor – one of the professors involved with the course. Usually the tutors agree upon at least one weekly meeting with their project groups. It is required that teams make their own time schedules for the project, showing which member of the team is responsible for the particular parts of the project. At the end of the semester a new time schedule is made to compare with the first one, with an explanation of why any difference occurred and how to make more realistic plans in the future. The PROE4 project challenges the students to find individual solutions to engineering problems. The “correct” solutions to the problems in PROE4 do not exist. To fulfil the learning outcomes of this course the students must be able to:

1. Use concepts, theory, components and methods introduced in the course;

2. Develop and use mathematical models of technical systems as introduced in the course;
3. Design, calculate, analyse, model, simulate, construct and test complex systems microcontrollers, digital hardware, analogue hardware and software;
4. Plan, specify, cooperate, make documentation and use relevant engineering terms and language;
5. Communicate clearly both orally and in writing;
6. Cooperate with others in team;
7. Relate specifications, calculations, simulations and measurements and draw clear and relevant conclusions;
8. Hypothesize the reasons for differences between simulated and actual results and discuss the results.

### IHK's one semester project programmes

The success of this particular fourth semester project inspired us to start other international project semesters, namely the European Project Semester (EPS), the International Business Semester (IBS), the International Design Semester (IDS) and the International Design Semester (IDS) [3]:

*European Project Semester (EPS)* is a full 30 ECTS project-based course where teams of 4 to 6 international students undertake an industrial project. The EPS has very wide scope and attracts students from all traditional categories: civil, electrical, mechanical, production, as well as students taking broader based courses that include computing, business, IT, and more.

*International Business Semester (IBS)* – in this programme, the 30 ECTS credits are made up of 5 equally weighted taught modules and a 5 ECTS project, carried out during the second half of the semester. The knowledge gained from the taught modules is applied in the project. The projects are again sponsored by local businesses or industries and are much smaller in scope than for the EPS program.

*International Design Semester (IDS)* – in this program there are three modules of 5 ECTS credit points and a 15 ECTS point project running concurrently. During the project, international engineering students from Copenhagen University College of Engineering and design students from the Danish Royal School of Architecture work together in teams.

*Innovation and Entrepreneurship Semester (IES)* is designed to train engineering and business students in innovation, entrepreneurship and marketing in a global environment. The IES is a full semester load (30 ECTS) and consists of 4 courses and a project:

- Marketing Across Cultures;
- Innovation and Entrepreneurship;
- From Local to Global Business;
- Multimedia;
- Innovation and Entrepreneurship Project.

Table 1 shows the list of the countries sending students for exchange to IHK since 2002.

**Table 1.** The list of the countries sending students for exchange since 2002

Country	EIT	EPS	IBS	IDS
Australia		X		

Country	EIT	EPS	IBS	IDS
Austria	X	X	X	X
Bangladesh		X		
Belgium	X	X		X
Chile	X	X	X	
China	X	X	X	
Czech Rep.	X	X	X	
Denmark	X		X	X
Ecuador		X		
Estonia	X		X	
Finland	X			
France	X			X
Germany	X			X
Hungary	X	X		
Ireland		X		X
Italy		X	X	
Latvia	X	X		
Lithuania	X			
Mexico			X	
Netherlands	X			X
Norway	X	X		X
Pakistan	X	X	X	
Poland	X			
Portugal	X	X	X	
Romania	X	X		X
Spain	X			
Slovakia	X	X	X	
South Korea		X		
Sweden		X		X
Taiwan		X		
UK		X	X	X
USA	X			

### Supervising international teams

The early stages of the semester are mostly used to develop team-working skills and project management skills, especially in groups with international students. As the semester continues, weekly meetings are held with the supervisor and progress is regularly reviewed. Each team makes two or three presentations during the semester – the first to show their initial planning; the second to show progress (optional) and the third is the final presentation which takes place after submission of the final report and is part of the final examination. Dealing with students having different background and coming from different cultures makes it necessary to train the students to manage the following skills:

- Project management and leadership;
- Basic work skills like self management and presentation skills;
- Team training - cooperation with others, especially with other team members;
- Communication and presentation/sales skills;
- Conflict management.

The challenge of supervising the international groups is to motivate the students with different prerequisites to study the theory and share their knowledge with others, and work in teams with other students from very different cultures. Some of the students have a very good background in mathematics and physics, but their practical experience may be rather poor. Some of them do not have much experience in working with projects. Danish students choosing our University College of Engineering in Copenhagen are mostly interested in practical aspects of engineering and are used to work in

teams at high school. They are trained to work independently and are used to work towards finding their own solutions to the problems, and have no problems in getting in touch with different teachers/professors or companies in order to get help.

## Conclusions

Our Project-Based Courses are undoubtedly being a success. In the case of the international students, it increased student mobility and provide a positive environment for our Danish students. Students experience the difficulties of cultural differences and develop skills to communicate effectively. Student's motivation, both Danish and international, to learn is very high and the teams work very hard to finish their projects.

The following conclusions are drawn from our work with international teams.

- It takes from 3-5 weeks on average for exchange students to adapt to "teamwork" and to study independently with the project.
- Exchange students are usually good in theoretical skills, but too often look for "the right solutions".
- Teams with only international exchange students usually have problems with how to manage the project, because of the insufficient practical and/or theoretical skills, and they are often too late in asking the supervisor, the tutors or other students for help.
- Teams with only Danish students are best in managing the practical skills.
- Teams with international students are most diligent with theoretical disciplines.
- Looking at the outcome of the project - there is no evident difference between teams.

However, there were some common problems we met during last three years.

- Some team members do not keeping their agreements and hence contribute to the delay of the project, Danish teams are best to solve these problems internally. Other teams must be always helped with these problems.
- Conflicts according to cultural differences in mixed groups, like who decides how to hand out the tasks. It is very important for the supervisor to write "a contract" where all group members are obliged to solve certain parts of the project.

- Communication or language problems in mixed groups. It is easy to avoid these problems if the supervisor requires frequent meetings, more than once a week, or a written report at each weekly meeting.
- We have had some cases, where a single team-member left the team, mostly because of the insufficient contribution to the teamwork, but also due to cultural differences.

Some of the exchange students ask to stay for an additional semester at our university, because they liked our project-based learning method and practical approach to the theory during the exchange semester.

## Acknowledgments

I would like to thank my colleagues, the professors I. L. Christoffersen and D. Ashworth, at the Copenhagen University College of Engineering, for our good discussions and close cooperation. Thanks to all the students for valuable discussions on future development of our courses, and special thanks to I. Stauning and J. Greve for technical support.

## References

1. **Andersen A.** Implementation of engineering product design using international student teamwork – to comply with future needs // *European Journal of Engineering Education*, 2001. – No. 2(26). – P. 179–186.
2. **Tranter I., Brown F.** A synergy of cultures – the place of multidisciplinary teams in final year undergraduate design projects // *Proceedings of the Second International Symposium in Engineering Education*, 1994.
3. **Larson E. C., La Fasto F.** *Team Work*. – New York: McGraw–Hill, 1989.
4. **Heitmann G.** Challenges of engineering education and curriculum development in the context of the Bologna process // *European Journal of Engineering Education*, 2005. – No. 4(30). – P. 447–458.
5. **Fink F. K.** Integration of Work Based Learning in Engineering Education // *31<sup>st</sup> ASEE/IEEE Frontiers in Education Conference*, 2001.
6. **Friesel A.** Learning Robotics By Combining The Theory With Practical Design And Competition In Undergraduate Engineering Education // *AutoSoft Journal, International Journal on Intelligent Automation and Soft Computing, Special Issue on Robotics Education*.

Received 2010 05 04

## **A. Friesel. Preparing Students for Globalization – Working with International Teams with Projects // *Electronics and Electrical Engineering*. – Kaunas: Technologija, 2010. – No. 6(102). – P. 111–114.**

This paper summarizes the activities, contents and overall outcomes of our experiences with international students studying at the Copenhagen University College of Engineering (in short - IHK); in particular students coming for one semester exchange program under Erasmus-programme. IHK's participation in EU-supported programmes like EIE-Surveyor and ELLEIEC, both ERASMUS thematic networks, have the positive influence on number of our partnership agreements with other European universities. Globalisation makes it necessary to cooperate on an international platform. At the IHK we have more than 50 active Erasmus agreements. We also have bilateral agreements with many non-European countries, for example: USA, China, Korea, Mexico, Chile and others. We describe our experiences of working on industrial projects with international teams and analyse the development and trends in student mobility. The growing popularity of these programmes and the increasing number of the students joining our international semesters demonstrates the success of this form of education. Equally, the growing number of projects coming from industry demonstrates their positive interest in these kinds of skills for their future employees. Bibl. 6, tabl. 1 (in English; abstracts in English, Russian and Lithuanian).

**A. Фриесел. Подготовка студентов современного общества на основе международных проектов // Электроника и электротехника. – Каунас: Технология, 2010. – № 6(102). – С. 111–114.**

Описывается опыт обучения студентов с разных стран мира в Копенгагенском университете. Большое внимание уделяется студентам (США, Китая, Мексики, Чили и других стран), которые по программе ERASMUS прибывают на один семестр обучения. Анализируются тенденции и мобильное развитие студентов с учетом программ EIE-Surveyor, ELLEIEC, ERASMUS и др. Общее внимание представителей промышленности показывают целесообразность проведения таких международных проектов, что постоянно увеличивает рост студентов. Библиографический список: 6, табл. 1 (на английском языке; рефераты на английском, русском и литовском яз.).

**A. Friesel. Studentų ruošimas globalizacijai – darbas su tarptautinėmis komandomis bei projektais // Elektronika ir elektrotechnika. – Kaunas: Technologija, 2010. – Nr. 6(102). – P. 111–114.**

Perteikiama kitų šalių studentų, studijuojančių Kopenhagos universiteto inžinerijos kolegijoje (KUI), mokymo patirtis. Daug dėmesio skiriama studentams, atvykstantiems vienam semestru pagal ERASMUS mainų programą. KUI dalyvavimas ES remiamose programose (EIE-Surveyor, ELLEIEC, ERASMUS) teigiamai veikia partnerystę su kitais Europos universitetais. Dėl globalizacijos bendradarbiavimas tarptautiniu mastu tapo būtinybe. KUI turi daugiau nei 50 galiojančių ERASMUS sutarčių bei dvišalių susitarimų su daugeliu ne Europos šalių (JAV, Kinija, Korėja, Meksika, Čile). Analizuojama studentų mobilumo plėtra ir tendencijos. Didėjantis šių programų ir projektų populiarumas bei augantis studentų skaičius atspindi tokios mokymo formos sėkmę. Daugėja projektų su pramonės atstovais. Tai rodo jų teigiamą susidomėjimą tokiais projektais bei jų metu įgytų įgūdžių pritaikymu pramonės sektoriuje. Bibliografinis sąrašas: 6, lent. 1 (anglų kalba; santraukos anglų, rusų ir lietuvių k.).

DOI: 10.5755/j02.eie.9371