

International Engineering Students in Cross-cultural, Interdisciplinary Teams

Joergen HANSEN

Copenhagen University College of Engineering, Lautrupvang 15, 2750 Ballerup, Denmark, jha@ihk.dk,
www.eps.ihk.dk

KEYWORDS: *International, cross-cultural, teamwork, projects.*

ABSTRACT: *Today it is obvious that most engineers in future will work in an international environment. Further, the development of technology and science is so fast, that it is difficult to teach engineering students all the fundamentals and all the newest results of science at the same time. Things have become more complicated, and as a consequence of this most engineers today work in interdisciplinary teams. Nobody is able to know and to do everything on his/her own.*

In Copenhagen University College of Engineering we have taken the consequences of this, and since 1995 we have had a "European Project Semester", EPS, for engineering students who have completed at least four semesters. In the EPS, after some initial courses, students work together in international, interdisciplinary teams on real-life projects, usually in cooperation with industry. Usually it is a great challenge for students to do this project work, because a part of it is to find the most important aspects of the problem and to define a problem statement. Further, they have to make plans for the project work. Most students are used to problems or project work that already has been defined by a professor.

We have developed a special assessment system that ensures that no students lean back and let the other team members do the hard work. Further, this system takes care that all group members get individual marks.

So far, we have had 469 students from 24 countries and from all fields of engineering in the EPS. It is our experience that students learn very actively, and most of them mature significantly during this semester. Especially the international experience seems to be very motivating. It is a challenge to work in an international team because of the different cultural backgrounds, but students learn to appreciate diversity. We have received very many positive statements from our students and from professors from universities that send students to the EPS.

I don't believe that project based learning with teams of students working on interdisciplinary projects is the only good way to teach students. However, I am sure that it is one of the essential ingredients in a well-balanced curriculum. It is like food: You cannot say that one specific kind of food is good for your health and only eat this. Food, like teaching, should be a well-balanced mixture of many ingredients.

1 BACKGROUND

Hopefully, most of the students we are teaching today will still be working as engineers in 40 years from now. In other words, it would be nice to be able to predict future. Many wise people have tried, and most of them have failed (1). However, I dare to predict that society in future will become even more complicated and more international than today.

When I studied at high school and at the technical university many years ago, the world and our knowledge was less complicated than today. As a consequence we got a very broad education and learned a lot of different things, that young people don't learn to day. Formerly, many engineers could work on their own, but today the technology is so complicated that most engineers have to work in interdisciplinary teams to meet the demands. Technical skills are not sufficient; engineers need the ability to work in teams, usually together with people of different disciplines. As a consequence, communication skills are very important today.

Internationalisation is not a new invention. The German composer G.F. Handel moved to London almost 300 years ago, W.A. Mozart visited several countries more than 200 years ago, and many other cultural personalities operated internationally centuries ago. However, it is evident that today the world is linked closer together than ever before, especially when we are talking about research, education, labour-

force and markets. Today, all large companies are international and are operating worldwide. The economies of different countries are linked together, and progress or crises in one part of the world will affect the rest of the global economy.

For generations students have been used to sitting quietly and listening. Today, young people are used to a great variety of entertainment, and we want to give a much larger part of them a higher education. It means that we'll have to change our education systems if we want to attract a sufficient number of students.

In Copenhagen University College of Engineering we have created a "European Project Semester", EPS, which hopefully meets the demands of society, of companies and of students in future.

2 WHAT IS EUROPEAN PROJECT SEMESTER (EPS)?

European Project Semester is a semester for engineering students who have completed at least four semesters. From 1995 till 1998 it was only for European students, but since 1999 we have accepted students from all countries worldwide. Further, we have accepted a limited number of non-engineering students, if they are able to work in interdisciplinary teams with engineering students.

The EPS consist of a formally taught course program (5 ECTS) and a large, interdisciplinary project, usually carried out in cooperation with a Danish company (25 ECTS). All project groups are put together according to the students' fields of study and the demands of the projects. Further, all groups are international.

The overall aim of the courses is to help students to work in international teams and to carry out the project work. Those courses are "Team Building", "Communication", "Project Management" and "Systematic Innovation". Other courses are "Environmental Subjects", "European Law" and "Language", which means English and basic Danish.

3 WHEN AND WHERE?

EPS started at The Engineering College of Elsinore in 1995. In 1997 it was transferred to Copenhagen University College of Engineering where it is carried out every spring and every autumn semester. Others have adopted the EPS, and since 2002 Hogeschool 's-Hertogenbosch in the Netherlands has done an EPS every autumn semester, and Hoegskolen i Oslo has been doing an EPS every spring semester since 2003.

4 HOW IS AN EPS INITIATED?

Every May and November we select applicants for the EPS according first of all to their nationalities. A good, well-balanced mix of nationalities is important for the EPS-concept, but of course, other student qualifications are considered.

Those students who have been accepted receive a list of projects they can choose. Almost all of the projects are interdisciplinary, and most of them are done in cooperation with Danish companies. Some have been done in cooperation with Spanish companies, universities and organisations, and a few projects have been academic projects done without companies. Students shall send a prioritised list with at least three projects.

It is a nightmare to arrange the project groups! Of course, most of the students should have their first priority to be motivated. Further, the skills of the students in the groups should meet the demands of the projects. The group size should be 4, 5 or sometimes 6 students, and all groups should be international which means that they at least should include three nationalities. It is our experience that the international mix is very important for the students.

When the groups have been formed, every student receives an e-mail informing him/she about his/her project and names and e-mail addresses of the other team members. Students are asked to discuss with a supervisor from their home institution how they can contribute to the project work and to be ready to discuss and define the project when they start the EPS. Hopefully, students will be prepared for the EPS in this way, so that the semester can start effectively. Often they begin discussions about the projects by e-mail before they arrive in Copenhagen.

When project groups meet with supervisors from industry and from the engineering college in the beginning of the EPS, they should discuss the projects. Companies of course have their own ideas, students know – hopefully – how they can contribute and what is required from their home institutions.

Supervisors from the engineering college will take care that the outcome of this discussion will be a realistic problem statement and a project of a good theoretical level.

During the first weeks there are courses like team building, communication and project management. At the same time, students start the project work by gathering information and step by step making the problem statements more precise. Further, they'll have to make Gantt Charts for the project work, define aims and objectives and find out which task they shall do.

5 PROJECT WORK

Often, when people are working together in teams, some team-members don't contribute effectively, and much time is wasted. People have to work in a well-structured way and to be motivated.

A team cannot work effectively without group meetings. On the other hand, many people have wasted too much time on meetings. So, we have to teach students how to prepare meetings and to make agendas, how to chair meetings and how to take the minutes of the meetings. All EPS-teams have meetings with supervisors at least once a week.

Supervisors, of course, should be able to answer technical questions from the students and to give good advice about the project work. However, this is not enough. It is very important that supervisors follow the teamwork and the group performance closely. Sometimes, students feel that the project work is fine and everything is O.K. Sometimes, they are frustrated and might tend to lose courage. Sometimes, there are hidden conflicts. Sometimes there are open conflicts; maybe because of misunderstandings caused by different cultural backgrounds. When 50 students of maybe 14 nationalities are working together in project teams, a lot of things can go wrong and a lot of conflicts can arise. It means that supervisors have to be aware of, able to and willing to help with all those problems and conflicts. Supervisors should not only be technical supervisors, but should also be able to facilitate and nurture the team process. If a student loses motivation, hopefully the supervisor will know how to motivate him/her again.

6 ASSESSMENT

When students are working on a group project work, the result will usually be a common report for the whole group. If some of the students are lazy or not motivated, they might lean back and let the other team members do all the hard work. The result will often be that the total performance of the team is too poor, and that some students pass the exam although they should not. Further, this situation will usually create conflicts. In other words, it is crucial that students get individual marks. In the EPS we have created a rather special assessment system to overcome these problems.

Twice during the semester the students have to do a self and peer assessment. Their opinions about their own and the other team members' performance are compared. They shall assess quality and quantity of the group members' technical contribution and various questions about how they are contributing to the teamwork. For some students it is a very instructive experience to see that the other team members have assessed them differently than they did themselves!

At the exam, it is crucial that students are assessed individually. Each student has to do an individual oral presentation, and when the report is gone over, we try to give each student an individual mark for the technical content and for the communication value. Further, it is important that the team process is assessed. Supervisors give each group an overall mark for the quality and quantity of the teamwork, but in each group students are asked to divide this part of the mark individually according to their individual performance. Some students don't like it, so we often ask them: Do you really think that all of you have deserved the same marks? Do you think that you or the supervisors are the best ones to assess this? Usually, students understand and accept it. Sometimes, they divide this part of the mark equally, but it is my experience, that those groups who have had problems with the teamwork really do an effort to distribute this part of the marks!

Hopefully, the outcome of our assessment system is that all students get correct, individual marks. Further, it prevents some students from leaning back, because they know in advance that they won't pass the exam if they don't contribute effectively. Another important outcome is that we avoid many conflicts about who is lazy and who is not!

7 CHALLENGES

It will always be a challenge to gather 50 students of maybe 14 nationalities and put them into international teams. Communication is not only a matter of language; the cultural background is important, too. Different people with different backgrounds interpret the same words differently. Different working habits, monochronic or polychronic culture, formal or informal culture, expressive or reserved culture, relation-focus or deal-focus and many other differences can cause misunderstandings.

In short, conflicts will occur. It is very important to be aware of this and help students to find out, what the problems are and how they can be solved. Some people tend to hide conflicts, which usually will make them grow more and more severe.

In Denmark the distance between students and professors is small. Some students used to a more hierarchical culture can misinterpret this. They can become frustrated when they find out, that it doesn't mean that the Danish professors will do some of the project work for them or give them higher marks than they have deserved.

Many things can go wrong and cause problems, but it is my experience that those students who apply for the EPS are aware of the importance of the international experience. It means that they basically have a positive attitude and want to overcome the problems. They learn to appreciate diversity.

8 BENEFITS OF THE EUROPEAN PROJECT SEMESTER

Our experience with EPS is very positive. So far, we have had 469 students from 24 countries and from all kind of engineering.

First of all, we see that this semester is very motivating, and students become committed. As a consequence, more students than usually will be creative and active. When the teamwork is good – which it usually is – we see a synergy and that the whole is greater than the sum. It becomes more “we” and less “you and I”. We see that students mature and take responsibility for their project work and for their learning.

I think that the international experience is the most important part of the EPS. The students are very different which can cause problems and conflicts, but students learn to appreciate diversity, and most of them tell us that the international experience was what they liked best. For most of them, EPS is the beginning of their international network. We receive much e-mail from EPS-students one, two or several years after the EPS, and we can see from the e-mail that they keep in touch with each other.

We have received many positive statements from EPS-students and from professors who know the EPS. Here are two examples:

Andrew Perez, mechanical engineer from Notre Dame, says:

“Let me start by saying that I cherish this (EPS) as much as I do my four years at Notre dame. I have learned more about myself, the world and life in the last five months than I have in my previous 24 years of living. I came to the program believing that with my credentials and experience, I would be able to easily succeed in this setting; I have never been so wrong in my life. My error was in that while I have experience working with Americans of various ages and egos, we are all Americans and therefore predominantly of the same mindset. When I started working within a multi-national team, I found myself having to reinvent my work habits, my communication skills and my choice of words. It was one huge and complete paradigm shift.”

Duane L. Abata, professor at North Arizona University, previous President of American Society for Engineering Education (ASEE), says:

“EPS is a unique concept and beneficial to all students who participate in the program. It is an outstanding opportunity for students to gain valuable international experience, which is very much needed in the global economy of today.

The friendships of today established among EPS students forms a valuable international network that will last a lifetime and serve them well in their professional career as engineers of tomorrow.

EPS students learn how engineering problems are tackled in other countries. In the global economy this is a valuable experience – an engineering problem does not necessarily have a single solution, but rather, many approaches and differing but effective and creative solutions.”

9 CONCLUSION

My conclusion is not that all teaching should be problem-based learning with students cooperating in groups.

Students are different and have different learning-style. Teachers are different and have different teaching-style. Different subject don't match the same teaching. Even the best teaching will be boring, if everything is taught in the same way. I think that teaching is like food: You cannot say that one specific kind of food is good for your health and only eat this; food should be a well-balanced mixture of many ingredients. Equally, teaching should be a well-balanced mixture of several ingredients. However, I am sure that a problem-based, international semester like European Project Semester is a good and valuable ingredient in a well-balanced teaching, and that the international experience is very important.

ACKNOWLEDGEMENTS

I would like to thank professor Arvid Andersen who got the good idea and started the first EPS in 1995.

REFERENCES

- [1] <URL:<http://rinkwrks.com/said/predictions.shtml>>