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## **Internationalisation of Postgraduate Programs**

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***Abstract** - This paper presents the efforts and experiences of globalisation of the study programmes within electronic engineering at Aalborg University. The Project-Organised Problem-Based Learning Model, which have been employed since 1974 is presented and discussed. The consequences this has for the international students are presented and discussed in terms of e.g. the teamwork situation, professional and cultural differences. A student enrolment programme, implemented through the provision of scholarships, jointly paid by government and industry funds is presented.*

### **INTRODUCTION**

Since 1996 Aalborg University (AAU) has offered engineering programmes conducted in English from Bachelors degree to M.Sc.E.E degree. Some initial findings on this topic were reported in [1]. Starting with two programmes – Acoustics and in Intelligent Multi Media (IMM) [2] and adding more programmes. Since September 2001 we are running 12 programmes conducted in English [3]. Students attending these programmes are coming from all over the World – mostly outside the European Union. This presentation will focus on experiences gained from this effort in globalisation. Aalborg University differs from most other universities by the pedagogical concept we have been implementing since 1974 – Project-Organised Problem-Based Learning (PBL) [4], [5]. Therefore the integration of students involves right from the beginning multicultural team working. Students with different cultural background and from different university traditions must learn to co-operate in teams on a full-time scale. PBL as it is implemented at Aalborg University will be introduced shortly. Further details on this concept can be found in the papers from Moesby and from Ene-mark in this Journal issues. This is followed by a presentation of how international students experience this, how they function in a teamwork situation, and experienced cultural- and language problems. The reactions from the Danish students are also discussed and some statistics on enrolment and geographical distribution of the students are shown. The scholarship programme introduced by the Danish government is presented, and a general discussion concludes the paper.

### **Problem based learning (PBL)**

In 1974 Aalborg University was established and at the same time project organised problem based learning was introduced into Danish engineering education. From the very beginning the key element has been project work. On each semester students must carry out a major project – approx. 500 hours of workload per student. With groups of 4-6 students this means 2000-3000 person-hours per project. This calls for a high demand of social, communicative and co-operative skills from the students. Because of the scale of the projects, there is

an inherent demand that the project subjects stems from real-life problems. Consequently there is a close cooperation with (often local) industry to identify engineering problems to solve. Each problem based project work comprises *problem analysis and problem definition* in engineering terms, *problem solving*, and *documentation* in terms of a report or a scientific paper and poster.

### The learning situation

Students at Aalborg University are organised as groups of up to six members. Each group is assigned an 18 m<sup>2</sup> “office” for the duration of the project period (one semester) which becomes their second home. This room is their base, in which they have discussions about the project, they carry out designs, simulations, communications etc. using the available software tools via the PC/terminal in the room, they drink coffee, and they put pictures on the wall, bring their own PCs etc. Group rooms have individual keys, which (apart from the building officer) are only issued to the group members. Another important function of the project group offices is connected to the learning process.

After each lecture of approx. two hours, the students are expected to go to their group-rooms to solve some assigned problems, simulations etc. based on the content of the lecture. This takes another two hours where the lecturer walks from group to group to facilitate the process. Hence, the students meets the lecturer “on their own ground”, which puts them more on an equal footing.

Being part of a team the students learn how to communicate and co-operate solving major engineering problems. They learn how to deal with professional discussions in situations like problem definition and argumentation for their choice of solution. Students learn how to argue about and explain in scientific terms what they believe is the right solution – it is not enough to claim you are right, you must be able to convince other group members. Likewise, they must be able to listen to their group members’ arguments and negotiate compromises. *Argumentation is a god way of learning.*

They learn how to organise teamwork, and learn that a team does not work if everybody does not do their part of the job. In this way the students assimilate an attitude to work differently from students doing traditional university study individually. In return to this the students will get the feeling of safe social surroundings, the other students expect them to show up every morning, and if they do not appear, they will probably be contacted to find out what is wrong.

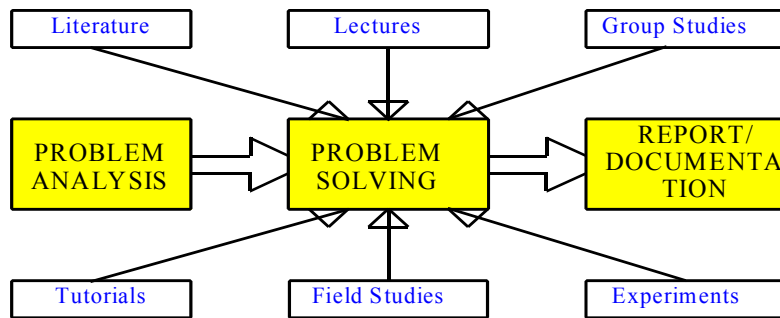


Figure 1: Principles of project organised problem-solving [4]

The teamwork also has the effect that students push each other. Of course the students go for solving the problem - engineering is problem solving, and they define some sub-tasks for each member of the group. To succeed with your task, you have to read the book, seek out some extra information, read some scientific papers, search the Internet, and do some programming or whatever is needed. And as no student want to end up with a bad solution, they work very hard with their project. The project is the key element in the curriculum applying the theoretical courses in problem solving and via the project being able to reflect on their professional work.

Each project group is assigned a supervisor or facilitator. The facilitator meets with the group approximately once a week to discuss the progress of the project, to guide them back on the track if necessary and to

read and discuss drafts for their documentation. It is very important that the facilitator is aware of not being a problem solver, but a facilitator. At the end of the semester he is responsible for the final examination of the project together with external examiners appointed by the minister of education.

A consequence of the problem based learning model is that we see that on average, 80% of the students entering the university succeeds in finishing their study, and most of them manage to do it within the official duration of study time [6]. Compared to a traditional university [5] we see that problem based learning improves the learning effect twofold: 1) a completion rate of 80 is rather high, and 2) an average completion time close to the official duration is unusual. One can say that the students both learn and socialise professionally. Learning by discussion, argumentation and applying is a strong way of learning, both for the bright students and the less bright. We find no correlation between the entrance level of academic skills and the completion probability.

## **THE INTRODUCTORY TERM**

As can be understood from the previous section, the PBL approach is a very integral part of everyday life at Aalborg University (even the buildings, with an abundance of group offices, is proof to this). The international students enter Aalborg University at the graduate level (i.e. having completed their bachelor degree) and stay for 4 terms (2 years) to obtain their master degrees. We have realised that it is not possible for foreign students to be integrated directly into this structure from the day they arrive, and be expected to work together in groups with their Danish fellow students, who at this point have 3-4 years of experience with PBL. Therefore we have set up an introductory term for foreign students only. They must pass the examinations at the end of this term to be enrolled in the master programme.

### **Introductory curriculum**

Given the large variation in the background of the M.Sc. students starting at Aalborg University, the courses at this term were designed to bring the students up to a level that facilitate reading the courses during the subsequent programme terms. For some of the new students these courses refresh previous training, but for the majority the curriculum presents several new concepts. Subjects like stochastic mathematics and digital signal processing are considered to be corner stones for a majority of the programmes and, hence, four ECTS point courses are allocated for these two subjects. Other common courses are programming in C and Matlab to assist the students in their projects. Students that have completed these courses, clearly much easier integrate with Danish students at the following term and, in general, the outcome of their training in Aalborg is strongly improved.

A major objective of the introductory term is to give the new students experience in problem-based learning and team working. The term is therefore designed to ease this process by an initial problem definition phase along with a course in PBL. This course includes a number of hands-on exercises in teamwork that, hopefully, leaves the students with the feeling that a group of students solve complex problems better than any individual student. The problem definition phase covers the first five weeks and is concluded by a seminar where the groups present their problem analysis and plans for the remaining part of students following this term. All students and supervisors attend this seminar and feedback is received both on the content of the project and on the teamwork process. The design, implementation, and documentation phase of the projects covers the remaining ten weeks. During the entire term, the supervisors pay extra attention to the groups compared to ordinary semester projects to make sure that the group's progress satisfactorily. Project examination takes place soon after the reports are due which leaves sufficient time for eventual re-examination to take place before the semester ends. The students are both examined in the content of the report and in the process of their teamwork, including their ability to communicate with co-students and teachers. They have to demonstrate a capability to work in a group. The students must pass the project exams before starting on their chosen specialisation. This means that they can be prevented from further study if their technical or communication skills such as language skills or cooperative attitude are not good enough.

### **Cultural integration**

A challenge for students on the introductory programme is to adapt to the different culture at Aalborg University and in Denmark as general. In addition, the students also have to deal with a situation where they will have to interact closely through their project work with students from a number of other nationalities. The introductory academic programme is designed to provide assistance that allows students to adapt to this cultural challenge. The aim is to

- Develop within all students the skills and the learning habits that allow them to interact with staff and students at Aalborg University and benefit from the learning concepts used.
- Enable students to appreciate, benefit from and contribute to the richness and diversity of the student body.
- Encourage students who will accept responsibility and make positive contributions to an increasingly interdependent and multi-cultural world.
- Create an academic understanding among the students that fosters intellectual tolerance, freedom, and integrity.

Services provided include academic supervision, cultural courses, a buddy system (a voluntary Danish student that helps with practical issues and gives an introduction to student life in Aalborg), and language assistance. To address specific the learning practice associated with problem based learning a specific course is given on that subject.

To facilitate a smooth integration into student life at Aalborg University the students go through an introduction week with limited academic lectures. During this first week new students are introduced to the various services offered by the university. Danish graduate students typically handle this introduction. This student or buddy will help the foreign students during their first time with practical problems and serve as a guide to the university services and student facilities. In addition the first week include a course, "Orientation to Denmark" - a course that explores the challenges of cross-cultural integration and deals with Danish cultural issues.

During this first week the students are also introduced to their academic supervisor. The supervisors are given extra time to deal with problems that arises due to different learning habits and cultural issues. Typically supervisors meet with the students once a week and try to oversee the academic progress as well as help to resolve cultural problems. A small social gathering is arranged at the end of the week to allow a more informal discussion with supervisors and buddies.

The foundations for successful studies also rely on that the students establish a strong social network during this introductory programme. Experience shows that the common excitement and confusion experienced during the first time forms a basis for generating a network of people or friends that they benefit from during the remaining part of their studies.

## **INTERNATIONAL STUDENTS' EXPERIENCES WITH PBL**

A traditionally critical point is the formation of groups at the beginning of each term. Groups are formed among the students having chosen a particular study programme. They are partly formed from professional interest in a particular subject, or, just as commonly later on in the programmes, from personal preferences. Fortunately, the formation is usually relatively unproblematic, the "native" students simply forming the groups and assimilating the foreign students. As a rule, groups must include both Danish and international students at the programme terms. At some programmes, social activities are used to integrate the students; e.g. the groups are given the responsibility to arrange a party. After the first project period, preferences for group members for Danish and international students seem to be on an equal footing.

When problems occur, it is the responsibility of the semester co-ordinator to mediate and make sure all students are put into a group.

### **Experiences from group work**

Generally speaking, most of the students quickly learn to function well in the teamwork situation, but a number of problems have been experienced. Apart from difficulties with language (which are discussed below) these have nearly all to do with a different background in the way the study is organised. Although most stu-

dents have tried to work in teams at least once and doing a major project assignment, the proportion of time spent on the project is much larger than they have previously experienced. Many students are unprepared for this, and care must be given to explain it to them. Also, the dependency between the group members is very large. Being responsible not only for your own study, but also for your fellow students, is an unknown concept for some students, which sometimes leads to problems.

A study among the international students was conducted at Aalborg University in 1999, and showed that 26% (of 69 participants) found some aspects of the process problematic [6]. However, there is a fine line dividing what is perceived as problematic and what is considered as challenging in a positive respect. One question from the study was:

*"If you could choose a parallel course of study here that did not use group work, would you choose that instead of working in groups?"*

One of the responses were:

*"- No. I think for the purpose of the challenge, different way of learning things. The purpose of learning abroad is, I think, to adjust to another way of studying. That's why I am here. So even though there are many challenges in group work, many challenges and difficulties, I still think it is useful for myself. I would definitely choose the group problem oriented."*

([7])

### **Cultural differences**

Based on our experiences it is not possible to form general conclusions about particular problems being related to a certain cultural or ethnic background. This is also the case in the study reported in [6]. However, concrete events indicate that problems sometimes occur, which may have cultural roots. As examples can be mentioned: Chinese students feel very strongly about "loosing face". Therefore they do not want to involve the supervisor in for example solving group internal problems. Students from Africa do not (at their arrival) fully appreciate how important "being on time" is in Europe, that it is very important to keep your appointments etc. (they quickly realise this, though). Students from Europe "claim their rights" and would ask for changes in the programme if it is better for their private planning, whereas a Chinese student would never "cause problems" for the professor.

### **Language skills**

In our experience, the most deciding factor for a student succeeding is his/her proficiency in (English) language. At a more abstract level this can be seen as the ability to communicate. Even though most students are quite capable of (and used to) following lectures and reading literature in English, most of the day is spent communicating orally with his/her fellow students. Also all written material must be in English, which is hard for many students. The requirement for being admitted is a score of 550 in the standard TOEFL-test (being the only worldwide English test), which tells nothing about conversational skills. This is also concluded in [7]:

*"The most often cited problems with using English were those involving communication among foreign students from different parts of the world where English is used as an official second language or is only learned as a foreign language. Differing accents, pronunciation and syntax customs often made communication difficult, a problem that was mentioned particularly in connection with group work. It was also reported that some foreign students were so poor at English that they couldn't contribute to group work and, in one instance, that a student wrote in his native language after which a fellow countryman translated into English.*

....  
*Some of the problems experienced with using English to communicate among foreign students doubtless reflect inadequacies in English qualification testing at foreign universities. Other problems, however, appear to stem from regional differences in using English. Even though students from the same part of the world understand each other's spoken English without problems, local language conventions can make it extremely difficult for people from other parts of the world to understand what is being said. In some instances, these*

*problems can give rise to further misunderstandings, especially in groups that suspect they are discriminated against for other reasons.”[7]*

Students (both Danish and international) are offered courses in English language both oral and written, but these are advanced level (e.g. “Scientific English”, for writing professional reports and papers), and cannot amend more fundamental problems. It is hard to make generalisations, but it seems that West European students experience the least problems, where East European, Middle and far East, and to some degree African students suffer more from language problems.

### Reactions from Danish students

The Danish students’ situation is of course influenced by the arrival of the International students. The most obvious change is that they have to switch to English. Maybe less evident is the fact that, due to the team work model, the assimilation of inexperienced students into the groups might directly affect the grade given for the project work. In general, this doesn’t seem to be something that concerns the Danish very much, but in some cases there has been a reluctance to accept new members into the groups. Furthermore, the Danish students are also actively helping the new students getting settled in, and form a social network.

A further indication that this is not a major concern for the Danish students is that the two most popular graduate programmes among the Danish students (Intelligent MultiMedia and Mobile Communication) are also those with the most International students (35-80% of the total number of students).

### Enrolment

Foreign M.Sc. Students arrived Sept.00 / Febr.01									
<i>W.Europe</i>		<i>E.Europe</i>		<i>M.F.East</i>		<i>Africa</i>	<i>N.+S.America</i>		
Austria	1	Lithuania	13	Bangladesh	1	Cameroon	2	Mexico	2
France	11	Romania	4	China	13	Ethiopia	2	USA	1
Germany	2			Indonesia	1	Ghana	2		
Spain	1			Iraq	1	Vietnam	1		
				Israel	1	Zambia	1		
				Pakistan	3				
<b>Total</b>	<b>15</b>		<b>17</b>		<b>20</b>		<b>8</b>		<b>3</b>

This section discusses the enrolment of students. At the initiation of the programme a large number of leaflets and posters were printed and distributed to more than 500 universities and institutions throughout the world. At the same time the material was placed on the web, together with application forms, applications for student housing, etc. However, an investigation later showed that applications almost exclusively originated from the web, or from word of mouth. As a consequence, advertisement is now only done on the web.

Foreign M.Sc. Students arrived Febr.00									
<i>W. Europe</i>	<i>E. Europe</i>	<i>M.+F. East</i>	<i>Africa</i>	<i>N+S America</i>					
France	5	Bulgaria	2	China	5	Ghana	3	Mexico	2
Greece	1	Hungary	1	Pakistan	2	Egypt	1		
Italy	1	Lithuania	8	India	1	Nigeria	1		
Spain	2	Romania	1			Vietnam	1		
<b>Total</b>	<b>9</b>		<b>12</b>		<b>8</b>		<b>6</b>		<b>2</b>

Foreign M.Sc. Students arrived Sept.01 / Febr.02									
W.Europe		E.Europe		M.F.East		Africa		N.+S.America	
Cypres	1	Lithuania	2	China	5	Cameroon	1	Chile	2
France	24	Romania	4	Pakistan	2	Egypt	1	Colombia	1
Spain	1			Thailand	1	Ghana	5	Guatemala	1
						Vietnam	1	Mexico	1
Total	26		6		8		8		5

Table 1. Recruitment of students

Table 1 shows the distribution of the International students starting February 2000 at the 8 programmes, followed by the number of foreign students arriving for the academic years 2000/01 and 2001/02. The September enrolment is for the introductory semester, and February enrolment for the M.Sc. programmes. As can be seen, the majority comes from Europe, but the relative high number of French students is due to the fact that we have a special agreement with some French engineering schools/universities. The decrease in the number of Chinese students enrolled lately must be seen as a consequence of some poor experiences with Chinese students language skills. Note that only students who are admitted for the full M.Sc. programmes are included in the table. Counting one-semester exchange programme students (nearly all come from Western Europe) and the Danish students (approximately half of the students are Danish), there is a clear dominance of European students.

### Scholarships

As in many other countries, there is in Denmark a strong demand for engineers, especially in the IT business area. The demand pt. exceeds the output from the Danish educational system. Therefore, the Danish government has initiated an extensive programme for provision of scholarships in order to attract foreign students. The intention is that the Danish government pays for the education (there are no tuition fees at Danish universities), and also for the living costs (in collaboration with companies, see below), which are prohibitive for most non-west European students. In return, it is the hope that a reasonable proportion of the students get jobs in Denmark and stay for a number of years before returning to their home countries. However, there is no compulsion to do so.

Foreign M.Sc. Students			
Academic Year	Admitted	Arrived	Scholarships
Feb.97	7	2	0
Sept.97 / Feb.98	31	9	2
Sept.98 / Feb.99	52	19	1
Sept.99 / Feb.00	103	50	26
Sept.00 / Feb.01	117	50	21
Sept.01 / Feb.02	110	53	8
Total	420	183	58

Table 2. Statistics for admitted students, students who actually commenced their studies, and the number of students with scholarships.

Table 2 indicates a sharp rise in the number of arriving students, due to the governmental funding of scholarships initiated in the academic year 1999/2000. It can be seen that only a third of the admitted students actually succeeds in getting to Denmark and start their studies without scholarships. This number increases to approximately one-half after the introduction of scholarships. This is partly due the fact that students in many cases cannot apply for funding (from foundations, companies, etc.) until they have been admitted and may subsequently be forced not to start their studies. Other problems are insufficient student housing in Aalborg, and sometimes obtaining visa, which can be a problem, especially for third-world countries.

### **Industrial funding**

As mentioned earlier, Aalborg University has a very strong tradition for doing PBL in collaboration with industry. As an example, a majority of M.Sc. students are completing their Master Thesis project in some form of collaboration with industrial partners such as LEGO, Bang & Olufsen, Siemens, Nokia and Ericsson. The benefits are mutual. The student's work on real-life engineering problems, often receiving support in the form of equipment or access to in-house expert knowledge, and the companies receive a thorough analysis and proposed solutions to their problem, as well as a base for recruiting the students when (or before) they graduate.

Given this background, it was only natural to seek support from some of Aalborg University's traditional collaboration partners, and as can be seen from table 2, a few scholarships were donated.

However, it was not until the government scholarship programme was initiated that companies were readily committing themselves. An important condition for the public funding is that for every scholarship, a company should cover a third of the costs.

When a student applies for a scholarship, a university committee evaluates the application, and depending on the outcome of this, the application is forwarded to companies who are considered to be interested in sponsoring. Often companies directly target their donations to students following specific programmes. E.g. Nokia and Siemens Mobile Phones each sponsored four IMM and four Mobile Communications students in 2000.

### **DISCUSSION**

In this paper we have presented some experiences from globalisation of the en M.Sc.E. programmes at Aalborg University. While the PBL in combination with project oriented teamwork has proven its worth; it is a very different situation from what most students have been used to. A number of problems have been experienced concerning educational background, language and different professional levels, and as a consequence an introductory half-year semester has been introduced from the autumn 2000.

An important issue is the enrolment of students. A scholarship programme has been initiated, where government funding is combined with company sponsorships.

A large number of well skilled B.Sc.E.E candidates around the world are looking for an opportunity for studying abroad and combine further professional development with personal development and exploring another part of the world. On the other hand, industry in Electronics and IT is an international business and expanding worldwide. In the information society more and more (consumer) products contain an increasing amount of knowledge. Knowledge and competence has become one of the most competitive parameters in the IT-industry. Therefore, graduates with the highest competence are needed worldwide. These needs and wishes are combined in the initiative taken by AAU and described in this paper.

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