
International Experience During Study: A Way of Preparing Engineering Students for Their Professional Career*

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Goals of the Technical University of Denmark (DTU) are to provide an education and to perform research in technology which meets society's demand for sustainable development and high quality. Graduates from DTU are increasingly employed in jobs in which they are dealing with international partners, participating in joint international research projects etc. DTU is aware of this trend and has developed a *Strategy and Action Plan* for the internationalisation of studies. Students at DTU are highly encouraged to take a semester or two abroad in order to earn an invaluable quality for their professional career: the ability to function in an international setting.

INTRODUCTION

Much thought at the Technical University of Denmark (DTU) has gone into the question of how best to prepare graduates to be internationally competitive, that is, to be *global engineers*. Obviously a global engineer must have a solid background in engineering subjects; if, five years ago, we had been asked what the vital ingredient for the education of an engineer is, we would probably not have added much to this assessment. Danish industry, at least, would have said:

what you should do as an institution is provide your graduates with a solid background in engineering subjects, they should know their maths, physics, chemistry and thermodynamics. The rest we will teach them on the job. Give them a proper knowledge platform and we will do the rest.

A NEW CONCEPT

Fortunately attitudes are now changing. Nowadays we think that our graduates should also be provided with an international platform as a foundation for their

careers. With this in mind, language skills are essential for engineers who are operating in the increasingly global environment. In Denmark, which is a small country, it is necessary to speak one or two foreign languages in order to be able to compete internationally. On the other hand, competency with foreign languages is not a skill that should only be limited to those whose mother tongue is not English. An engineer should be able to work in another language than their mother tongue; learning a second language imparts cross-cultural skills and provides the individual with the ability to work in a multicultural business.

THE PROCESS OF INTERNATIONALISATION

There are two aspects to establishing an international programme at an academic institution: the programme must comprise a study-abroad aspect as well as internationalisation of the domestic courses of study. Study-abroad periods, and the competencies that they impart to students, should be recognised in terms of credit points based on content. If study-abroad periods do not earn credit points, students will not go abroad. Their parents are likely to say:

we will not waste money on sending you somewhere if it is not adding credit-points to your curriculum when you are back home. We want you out of our hair, at least within 5-6 years. We simply cannot afford more than that!

* An expanded version of a keynote address presented at the 1st Asia-Pacific Forum on Engineering Education, held at Monash University, Australia, in 1997

* By popular vote of Forum participants this paper was awarded the UICEE silver award (fourth grade) for the most significant contribution to the field of engineering education

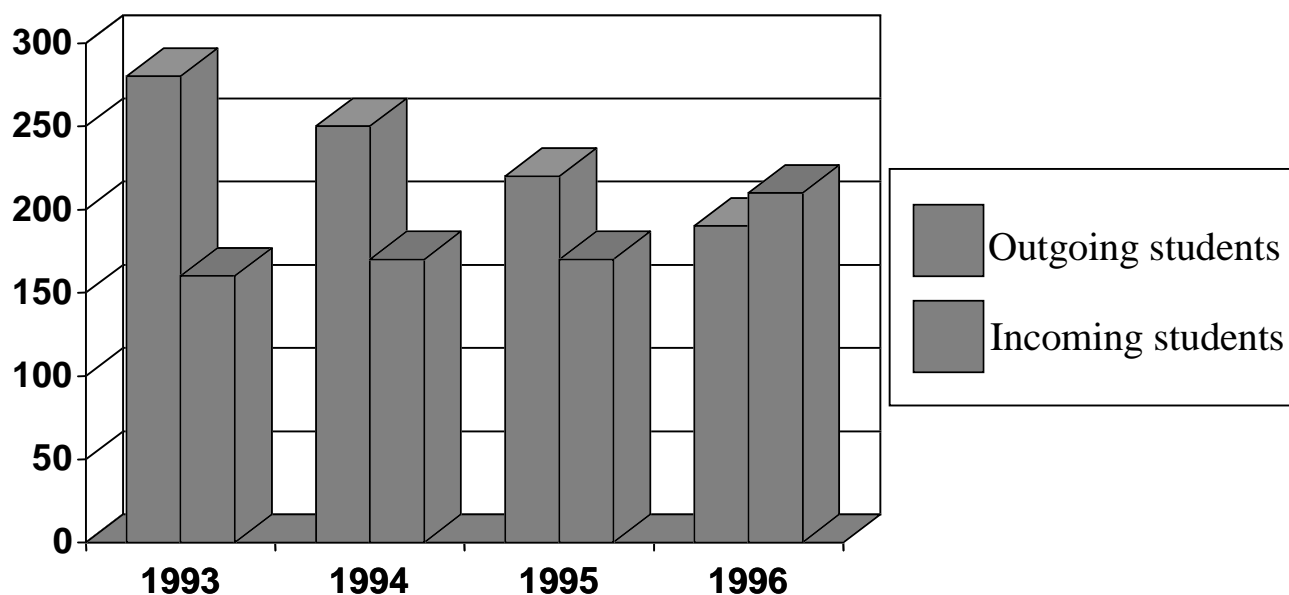


Figure 1: International student exchange - the DTU example showing the trend.

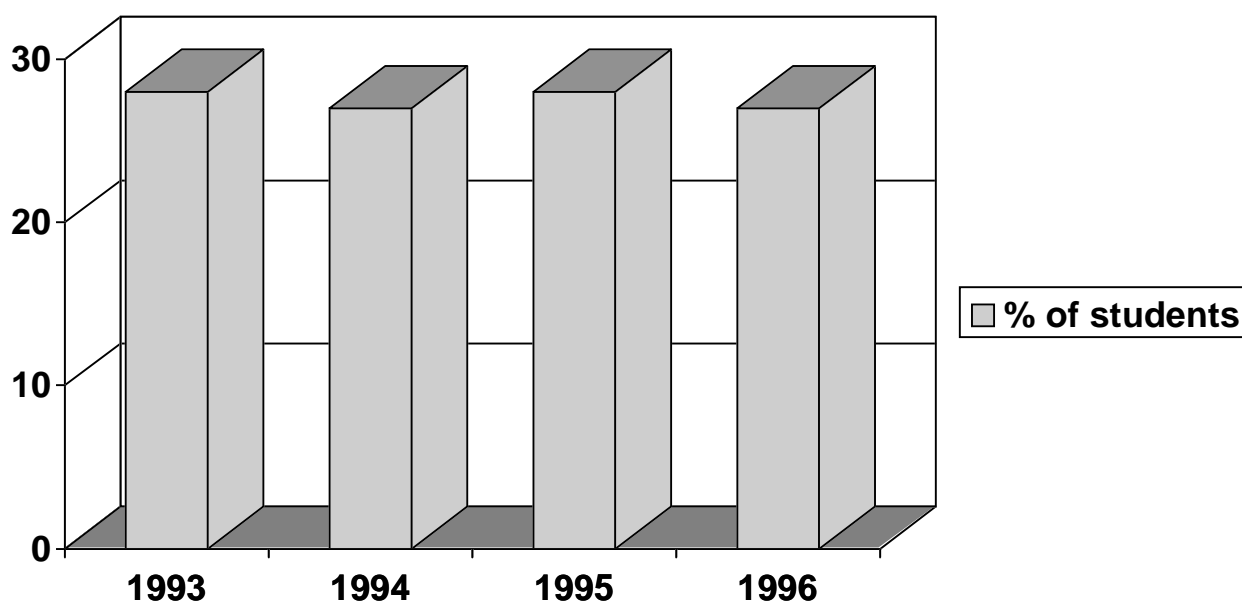


Figure 2: DTU outgoing students.

Awarding credit-points to returning students requires co-operative agreements with other universities, including transfer arrangements and tuition waiving systems. This of course involves rectors on the one hand, but certainly also faculty on the other: rectors may travel the world and sign any number of contracts, but unless faculty members are engaged in the process, unless they can agree with each other about how to transfer students, how to transfer credit-points etc, the contracts will not lead to anything. Consequently it is not only students, but teachers also who must be exchanged.

The study-abroad period could equally well be in a

university or company, but if it is in the latter, then it is necessary to engage and rely on a university in the foreign country where you are setting up the exchange agreement around the individual student.

Internationalisation of domestic study

The necessary complement to study-abroad programmes is internationalisation of domestic courses of study, that is, it is necessary to include international subjects in an institution's programmes of study; to make programmes attractive to international students; and to accept that a proportion of graduate courses is

going to be in English.

Under development at DTU is a course catalogue with a number of course packages offered over a semester and completely presented in English when there are foreign students in the classroom or lecture hall. This is obviously of benefit to foreign students, but from our perspective it is also of benefit to Danish students as they are acquiring an international attitude on their own campus. They have to acquaint themselves with English textbooks and with the English language in their work, and in that way they acquire an international competence both abroad and at home.

If Denmark is to expand its programme of internationalisation of studies, then it is vital that course programmes are presented in English because we cannot expect students spending a year or so at a Danish university to learn Danish in order to be able to follow a course programme, unless of course they come to study Danish or a specifically Danish subject (eg Søren Kierkegaard).

DTU AS A CASE

The exchange programme at DTU has developed along these lines over a number of years and there are several things that can be learned from this experience. One thing to notice is that the number of foreign students coming to DTU has been increasing over the years, and if we look at 1996 it is notable that the number of incoming students is greater than the number of outgoing students (Figure 1).

It may be observed from Figure 1 that DTU has been scaling down its efforts with regard to sending students abroad; however, the decrease in the number of students going abroad is related to the fact that there has been a relatively dramatic decrease in the number of students entering into engineering studies in Denmark. There seems to be a common international trend that young people are losing interest in natural science and technology, and DTU has lost approximately 50% of the intake it was used to. Five years ago the intake of Masters students was around 1,200; presently that number has dropped to 600, thus, to compare how the international programmes have been developing, it is necessary to convert to percentages of the intake (see Figure 2).

As can be seen from Figure 2, 30% of DTU's students spend at least one semester abroad during their study time of 5 years. This percentage is still considered too low, and a strategic plan has been developed that should see 50% of students spending time abroad by the year 2000, with the longer term objective of having all students by 2010 spend-

ing at least one semester abroad earning credit points to be brought back and added to their record at DTU.

At DTU we consider internationalisation to be an unavoidable and necessary process to pursue. The strategy has been developed and is now undergoing cost benefit analyses; at the same time, an internal organisation has been established to promote international experiences and international exchange of students and staff. To be international is an ongoing process; it is necessary to do follow-ups and to travel around the world to see other people in order to create networks.

Some statistics

Finally, some statistics about the destinations of our students. More than 50% of our students nowadays use the exchange programmes within Europe, but this number is actually declining. There is a growing interest in the United States and Canada, as well as Australia and New Zealand, and we are certainly also focusing on setting up programmes with Asia. It is a very positive trend that our students are interested in all parts of the world and are not only focusing their interest on Europe when study-abroad periods are under consideration.

CONCLUSION

From the DTU perspective, engineering education programmes have to fit with students' needs and interests. It is important to listen to what they are saying, not only with respect to the content of courses but also where they want to travel to. It is also necessary to tell our teachers that they must be aware of the international aspects of their material, and that they will need to work on redirecting their courses, that is, making them international and to be taught in English. They will have to do this in order to fulfil the requirements and needs of the institution, the requirements and needs of the students, and without extra resources put into their departments.

It is of the utmost importance that we all try to set up strategic plans focused on how to establish and maintain better contact with each other, to give our various exchange programmes *flesh and blood* so that presidents and rectors, when they are travelling the world and signing various co-operation agreements and letters of intent, know that somebody back home is willing to carry the workload afterwards. Maybe this latter issue is the most important because internationalisation does not come by itself, it is hard work but certainly rewarding when it is successful.

BIOGRAPHIES



Hans Peter Jensen received his MSc in chemistry from the University of Copenhagen and his doctorate from Chalmers University of Technology in Gothenburg, Sweden. He also holds an honorary doctorate from Shenandoah University in Winchester, Virginia.

Throughout his entire professional career he has been attached to the Technical University of Denmark but has spent several periods as visiting professor at the University of Oregon and at Chalmers University of Technology. His major scientific interest has been polarised light and its use within phase modulation spectroscopy, but since becoming a rector in 1986 he has been more involved in work with science and educational policies. In this connection it should be mentioned that he is Chairman of the UNESCO International Committee on Engineering Education (ICEE) and member of the Higher Education and Research Committee under the Council of Europe; that he was a member of the Danish Natural Science Research Council and, in connection with that, a member of and Chairman for Collaborative Research Grants Programme Panel under NATO Scientific Affairs Division. Hans Peter Jensen is furthermore a member of the Board of the Cultural Foundation for Denmark and Finland, the Fulbright Commission in Denmark and is serving on a number of national boards as a consequence of his rectorship.

He has published approximately 50 scientific papers in international journals and participates in the standing national and international debate on educational and research policies.



Michèle Gundstrup was until recently Head of the International Office at the Technical University of Denmark (DTU) and is now working as special consultant/adviser to the Danish Engineers Union.

Michèle Gundstrup graduated from DTU, Department of Chemistry, in 1991. After a short working period with research activities at DTU she became involved full-time in administrative matters, mainly internationalisation of studies at DTU. She was part of the team that established the International Office at DTU and has been responsible for co-ordinating several of the European programmes and overseas relations. In 1995 she was appointed to write the Acting Plan on internationalisation of studies at DTU as a follow up on that part of the University's Strategic Plan. She has been involved with the European Commission as Socrates promoter in Denmark.

During the last 2 years she has worked on bringing the strategy into practice; extending DTU's international relations, especially in the USA and Austral-Asia; extending courses given in English at DTU; and the management of the increasing number of student exchanges.