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# National Strategies for Staff and Faculty Development in Engineering Education in Denmark

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Increasing emphasis is being placed on establishing teaching and learning centres at the institutional level with the stated objective of improving the quality of teaching and education. In order to address this, Danish engineering institutions have created a national partnership to facilitate staff and faculty development. The national Pedagogical Network for Engineering Education (IPN), based in Ballerup, Denmark, was founded in 1996 and targets quality pedagogical and curriculum development of all Danish engineering education institutions: universities and colleges. This article describes Denmark's IPN, which consists of five engineering colleges and three universities, including Aalborg University, Aalborg, and the Technical University of Denmark, Copenhagen. The authors also offer reflections on the advantages and disadvantages of this strategy.

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## INTRODUCTION

Over the last eight years, issues concerning the quality of teaching and learning within engineering education programmes have featured more on the agenda because of new target groups, life-long learning and internationalisation. In order to support this development, teaching and learning centres have been established at the institutional level with the stated objective of improving the quality of teaching, and education as a whole.

However, the number of engineering institutions that have established teaching and learning centres are not growing. This is partly due to the fact that the institutions are too small and partly because the task of establishing these centres has not yet been given sufficient priority [1].

To address this issue, Danish engineering institutions have created a national partnership in the field of staff and faculty development. The national Pedagogical Network for Engineering Education (IPN - *Ingeniøruddannelsernes Pædagogiske Netværk*) was founded in 1996 with the aim of ensuring the quality of the pedagogical and curriculum development of all Danish engineering education institutions: universities and colleges.

## BACKGROUND AND OBJECTIVES

The IPN network consists of all engineering institutions in Denmark: Aalborg University (AAU), Aalborg; Technical University of Denmark (DTU), Copenhagen; University of Southern Denmark (OU), Odense; and five engineering colleges. The network was originally intended as a three-year project but was granted a four-year extension ending in 2003. The network is financed by the Ministry of Education's *Quality Improvement* pool.

The objective of the network is to strengthen the development of the pedagogical and didactic quality within the engineering education by:

- Inspiring, initiating and coordinating pedagogical and curriculum development activities in engineering education.
- Providing training and education in the field for part-time teachers, PhD students, assistant professors, associate professors and professors.
- Collecting and disseminating information concerning pedagogy.
- Initiating curriculum development projects at the institutional level.
- Creating a forum for the exchange of ideas and

experience at institutional, national and international levels.

The IPN is based upon the principle of decentralisation. Each institution has a part-time IPN staff member who is employed at 20% of full-time hours for this purpose. Two persons are employed full-time as day-to-day managers, and another full-time academic staff member has recently been added. A governing body has the overall responsibility for the network.

## THE RELATIONSHIP BETWEEN INSTITUTIONAL CENTRES AND THE IPN

At the time when the IPN was founded, Aalborg University and the DTU had already established institutional centres and had course and curriculum development programmes in progress [2]. As such, the institutions were on different levels in terms of the development and implementation of academic staff development.

From the start, a decentralised strategy was selected in order to gain the greatest advantage of the institutions' various competences within the field. Activities were to be adapted to each individual institution, with strong emphasis placed on the exchange of experiences.

Aalborg University and the DTU chose to retain the course already on offer. This was because, as universities, regulations concerning position structure have already resulted in compulsory pedagogic training for assistant professors. Both universities meet this requirement by conducting a mandatory course that covers approximately 200 teaching hours.

Although the colleges do not have any formal requirement for pedagogical training, they have created a tradition, which means that less experienced teachers must participate in pedagogical training. Therefore, most of the course activities (outlined by the IPN) addressed teachers at the colleges.

There is no doubt that this change has been easier for those institutions in which faculty development centres already existed because more persons have been involved in the pedagogic work at the institutional level. It has often been a somewhat *lonely* position for the employee who works with pedagogic development one day each week. Not only is pedagogy not very high on his/her colleagues' agenda, but it is also given low priority by the management. As such, the network also has to pursue the issue of increasing the qualifications of each individual employee, especially in terms of providing support for each other as much as possible in daily work.

In terms of the current situation in Denmark, a decentralised strategy was necessary. In other Scandinavian countries, other national strategies appropriate to their individual context have been chosen. For example, in Sweden, there is a national initiative within engineering education entitled NyIng [3]. Although the IPN and NyIng are organised very differently and possess different objectives, both are responsible for continuing and further developing the quality of pedagogy within the field of engineering education.

The Swedish initiative has been challenged with the renewal of engineering education programmes in Sweden, and Linköping University, Linköping, has been given the task of running this project in cooperation with other Swedish engineering institutions by the Swedish government. The project being conducted at Linköping University is aimed at modernising the educational programme leading to university degrees in the field engineering.

To address this issue, various projects have been initiated at Linköping University in an effort to discover future directions for engineering education. These projects include:

- Cooperation with industries.
- Technology-societies [4].
- Factors involving gender [5].
- Learning, assessment and evaluation [6].

In addition, several conferences were held for the purpose of exchanging experiences and spreading the knowledge gained.

The NyIng initiative is very centralised when compared to the IPN, and there are advantages and disadvantages associated with both types of strategies in terms of the organisation of staff development programmes adopted by NyIng and the IPN. In the case of NyIng, the primary advantage can be seen as a more focused profile, which creates a management perspective that is much easier to organise and direct.

The IPN has experienced some success with its decentralised strategy for organising staff development. Pedagogy has been placed on the agenda and is thereby discussed at all of the institutions. Specifically, within the technical colleges, the IPN has succeeded in placing pedagogy on the educational agenda by engaging approximately 25% of the staff from the various engineering colleges to participate in courses. On the other hand, experiences from the IPN indicate that such a strategy can also result in a network that can be difficult to coordinate and sustain.

## THE IPN'S ACTIVITIES

### Course and Seminar Activities

There are essentially three different types of courses that have been initiated as a result of the IPN; the first and foremost of these have been directed at the colleges.

Basic training courses for junior lecturers (assistant professors) and other teachers are a principal activity of the network. The prime objective of these specific courses is to support the development and qualifications of the individual teachers. These courses are not mandatory for teachers at colleges, although nearly all newly appointed teachers have attended the training. The courses consist of seminars and reflection in and on practice [7]. Based upon experience from the existing selection of courses at various institutions, the network will develop these courses further. Particular focus will be placed on newly employed teachers and attention will also be given to those courses for lecturers and temporary teachers so that they will be at the same level as the training courses for assistant professors at the two previously mentioned universities.

Special training courses on selected issues, such as project work and supervision, assessment, quality assurance, etc, have been conducted at the request of colleges and universities. These courses have a tremendous impact on the institutional culture as groups of colleagues share a common experience and develop a common language for discussing pedagogical issues. The IPN has been conducting these courses since its inception, as well as being in response to requests from IPN members at institutions.

The third kind of courses/seminars that the IPN has been running targets experienced teachers. These teachers are often decision makers, due partly to their experience and their positions on boards and committees. In this instance, there is a need to develop attractive courses or workshops that take the participants' experiences into account and, at the same time, offer new pedagogical (particularly didactic) knowledge. For example, technologically supported teaching requires new pedagogical considerations, which can be incorporated into both course and developmental activities. However, the IPN has encountered problems in attracting this target group and has found that it is most effective to integrate these teachers into training programmes by giving them responsibilities, like, for instance, supervising a new teacher.

Whenever possible, seminars are held in conjunction with other Danish networks and organisations, such as the Society of Danish Engineers. The IPN

still plays a role in the international arena, especially in relation to the European Society for Engineering Education (SEFI), which also organises seminars and conferences both in Denmark and internationally. More and more engineering staff members now participate in these arrangements, which can be strengthened by additional cooperation in the network.

Workshops and conferences have also been arranged in coordination with the IPN, including one that covered Problem-Based Learning (PBL) and another that dealt with developing assessment to support learning. The IPN also addresses institutional staff through, for example, a seminar entitled *Leadership and pedagogy – the pedagogy of the organisation?* Furthermore, the IPN was involved in an international workshop arranged in cooperation with AAU and SEFI on *Staff Development*. The workshop was very productive and resulted in a special edition of the *European Journal of Engineering Education* (EJEE) in autumn 2000.

The IPN recently organised a conference on the use of International Communications Technology (ICT) in engineering education, which was documented in the latest issue of *IPN-news*. General interest and problems concerning ICT may be the key to promoting a pedagogical dimension in teaching and learning in the near future.

### Curriculum Development Projects and Research

The IPN provides annual funding for the establishment of curriculum development projects. The amount of the funding is not huge, with approximately DKK 400,000 (53,830 Euro) being allocated for seven to nine different projects. As such, these are small projects, but this policy has functioned effectively with respect to the engineering education programmes, as well as for the universities. Initially, there was a problem with applicants not having adequate language skills to formulate pedagogic projects appropriately, given the applications were expressed in very technical terminology. Over time, there has been a greater focus placed on improving students' learning.

The allocation of funds to minor curriculum development projects has definitely had a positive effect on the institutions. The focus is not primarily on the qualifying of teachers, but rather the change of education. Thus, implementation and change perspectives have also been placed on the institutions' agenda.

Similarly, establishing more research-based development oriented work has also been considered recently. Because the network is a temporary project, and as the universities have established research-based

faculty development, this objective has not yet been achieved. However, if the IPN as a network is to continue, there is no doubt that it will be necessary to establish a more research-based and research related faculty development.

### Information Activities

A news magazine, *IPN-news*, which informs and discusses what is happening in the field, is published twice a year. The IPN homepage on the Internet provides up-to-date information concerning courses, seminars, etc [8]. While this is in Danish, it does have a short introduction in English.

The network gathers knowledge within the entire scope of curriculum development and pedagogy, including teaching experience, development work and research activities. Specific examples include collegial guidance, as well as tutor and mentor arrangements. Both the news magazine and the homepage include several short articles on these new teaching and learning methods. Such forms of experience exchange are maturing in other areas, but are still in its infancy within engineering education.

Assessment is another topic of current interest. Many teachers seek out ideas for alternative forms of teaching. Whether or not the effect of a particular form of teaching is scientifically proven is (for them) of less significance - the important thing is how it works for them. For the same reason, the experiences of others with new forms of testing, organisation and studying are a valuable source of renewal and inspiration for teachers.

Many resources have been allocated for these informative activities because the network considered it to be a motivating factor. After five years, there is no doubt that the pedagogy in engineering education carries much more prestige than ever before. Individual engineering colleges are now establishing their own institutional faculty development units.

### External Evaluation of the IPN

After the first three years of its operation, the IPN was evaluated externally by the Ministry of Education's Danish Centre for Educational Evaluation. The conclusion was clear: the pedagogic change process has great breadth and depth, at least partly due to the IPN's work, and there is a need for such a pedagogic environment that is suited to the engineering profession and enjoys legitimacy among teachers at engineering schools [9].

## STRATEGIES FOR FACULTY DEVELOPMENT

During this initial period, a change in the IPN's strategy occurred: from the rather rigid formulation on staff development with a focus on individual teachers to a focus on faculty development, with strong emphasis on changing the system. In other words, the focus has changed to the educational and institutional frameworks that impact the development of education. The qualifications of individual teachers is still important, but it is understood that it must occur in connection with the qualifying of the combined system in order to support the improvement of the students' learning [10][11].

Colet devised three different models for faculty development, namely the up-front, interactive and distributed models (see Table 1) [12]. The authors believe that the IPN covers two of these models and emphasises the third one in order to progress staff and faculty development in engineering education.

### The Up-front Model

The up-front model focuses on improvement of the individual teacher. Staff development is central with the development of a series of certified programmes. Typically, there are non-research-based centres situated in the administration, and generally there are teachers who are qualified in staff development. While the IPN still has this focus, it was initially its most dominant strategy.

### The Interactive Model

The interactive model focuses on the development of the system and therefore involves both counselling and curriculum development projects. Typically, this involves non-research-based centres located at the departmental level and usually involves a higher qualification level for staff and faculty developers compared to the up-front model.

Compared to the up-front model, the interactive model builds more on interaction and dialogue between staff/faculty developers and the ordinary teachers. The IPN has always included this strategy, but because some of the institutions are *pedagogically mature* and the teachers themselves approach with questions and requests, the basis for interaction is increased. In other words, there must be two actors involved for this strategy to function, and it is first necessary to establish a discussion and pedagogic reflective practice [13][14].

Table 1: Models of faculty development as derived from Colet [12].

	Up-front Model	Interactive Model	Distributed Model
Objectives	Training of the individual teacher	Improve the system for more effective learning	Community of learning
Focus	Better teaching within the existing teaching methods	Faculty and enhancement of teaching effectiveness	Action research projects and curriculum development projects
Activities	Training courses and comprehensive certified programmes	Counselling and curriculum development projects	R&D in the field of teaching and learning
Type of institutional centres	Non-academic teacher training centres	Non-academic teacher training centres	Academic centre for university teaching and learning
Organisation	Part of administration	Part of administration or research departments	Part of research departments
Type of faculty developer	Professional teacher qualified in staff development, university pedagogy and adult learning	Professional qualified in university pedagogy, faculty development, counselling and formative evaluation	Academic faculty developer focusing on creation of reflective practice

### The Distributed Model

The third model is the distributed model, which focuses on creating a new system and culture referred to as a community of learning. This model is based upon a research-based faculty development in order to facilitate action research projects run by faculty developers and staff and involves counselling regarding curriculum projects.

Currently, the IPN does not follow this strategy, but has formulated this approach as a prerequisite for the progression and improvement of future faculty development. Research-based faculty development is a requirement so that staff and faculty developers do not end up in pure pedagogical and educational pragmatism, but rather in evidence-based development.

A great deal of development in higher education is rather general and based on trial and error, despite the fact that it often occurs within research-based cultures. Action research is an obvious method for the improvement of students' learning because experimentation can coincide with evaluation; this paves the way for the creation of a reflective culture [15]. Learning is such a complex matter and is not becoming any less complex in terms of achieving new competences for life-long learning.

### CONCLUSION

Without doubt, engineering education in Denmark has benefited from the IPN. Formerly, it was inconceiv-

able to discuss pedagogical issues, but these issues have now become part of the culture and are thereby given higher priority. It has proven advantageous, even for those institutions with existing faculty development centres, because the external national network has given attention and priority to pedagogic issues.

It is also clear that it has been beneficial to adopt a subject focus. Pedagogy and theories on development must be contextual, otherwise they become too general and abstract for the teachers. However, most important is that the engineering context sets the requirements and provides the basis for this development, especially with respect to pedagogic and didactic theories.

Nevertheless, faculty development in Denmark has also reached the point where it is much more research based; otherwise those special elements in the educational change processes could not be captured. For example, very little is known about the change process from a teacher-centred approach to a student-centred approach in engineering [16]. Thus, in order to avoid repeating the same mistakes time and again, it is important to document the change processes.

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## BIOGRAPHIES



Ole Vinther is the Director of the Pedagogical Network for Engineering Education (IPN) in Denmark. He holds a degree in electronic engineering. Over the last ten years, he has been heavily involved in staff development for Danish engineering education, mainly related to pedagogical and didactic issues. He has been an active member of SEFI for many years and is now the national representative for Denmark.



Anette Kolmos, PhD, is an associate professor at Aalborg University, Aalborg, Denmark, and is former Director for the Centre of University Teaching and Learning. She was recently appointed Deputy Director for the UNESCO International Centre for Engineering Education (UICEE) European Branch and Headquarters at Aalborg University. Her major research focuses are Problem-Based Learning (PBL) and project work within engineering education, as well as the development of process skills. Since 1995, she has been actively involved in staff development and many change processes in higher education. She has also published several articles and books on this topic.