

IT and the management of distributed PhD study programs

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ABSTRACT

In the future, PhD level education, not the least in the IT area, will increasingly involve requirements for continuing education opportunities and support for distance education. This poses special challenges, since the depth required of a PhD graduate typically presumes on-site participation in the activities of a research group. In this paper, we discuss this development in the special perspective of PhD education in Computer Science. Three special challenges, the increasing need for inter-disciplinarity, access to industry as a laboratory and off-campus PhD training will be discussed in this paper. In particular, we will exemplify and discuss experiences from three Graduate School programs.

This paper is based on an invited talk given at the 5th Peder Sather Symposium, "Higher Education in the Digital Age", University of California at Berkeley, March 9-10, 2000.

Keywords

Distance education, doctoral studies, human-machine interaction, industry research school.

INTRODUCTION

The Computer Science department at Linköping University is heavily engaged in cooperative efforts with distributed PhD study programs, supporting doctoral students in linked Campuses or in industry. This presentation will discuss three different initiatives, a distributed HCI Research School, the Industry Research School and the Satellite University Colleges network. In particular, questions and ideas related to the prospects for IT support in this context will be raised for discussion.

The HMI Research School links two universities and five departments together in a joint initiative to provide an interdisciplinary PhD program in the area of human-machine interaction. The Industry Research School engages some twentyfive doctoral students sharing their time between sponsoring companies and the department, while

the Satellite University Colleges network presently supports around forty affiliated PhD students. This last activity is part of the national IT Uplift, where a major effort is made to improve the supply of IT faculty in the new Swedish Universities and University Colleges. Methods employed include building supervision networks, providing ambulating courses and retraining of PhD faculty from other disciplines into IT subject areas.

This review will offer few novel solutions of IT support for distributed PhD study programs, but rather confirm well established experiences of first generation IT-mediated distance education as well as contribute to a research agenda for the future.

THE GRADUATE SCHOOL FOR HUMAN MACHINE INTERACTION (HMI)

The HMI Graduate School [1], with the Swedish Foundation for Strategic Research (SSF) as major sponsor, is a joint initiative between Linköping and Stockholm since November 1997, when the first students were recruited. At present about 70 students are enrolled in the programme. More than 30 supervisors are engaged at KTH, Stockholm and Linköping University, respectively. A major part of the HMI budget is supplied by external sources, including industries and research agencies.

The goals are to support Swedish industry with excellence in human-machine interaction, and to enhance academic achievements in a global context. Research is primarily conducted with a focus in two main areas: IT design and interaction in real-time applications. Several interdisciplinary research themes are identified, for instance:

- Intelligent appliances and environments
- Joint cognitive systems engineering
- Multi-modal dialogue and information management

Design of computer-based artefacts and media from a human perspective builds on knowledge of computer science, usability and user-oriented design, as well as the aesthetic arts. Research on IT design considers usability of

products from both an individual and a group perspective, and when applicable simultaneously support the kernel activity of an organisation. Research on Real Time Interaction aims at collecting, analysing, presenting and conveying information for human decision making and human actions in real time, in particular with respect to collaborative process management [2].

HMI has increased the awareness of the importance of bringing together developers, manufacturers, researchers and users of IT products and/or real-time systems together. The graduate school has gained much interest from universities abroad, and co-operation in projects and student exchange is rapidly growing.

Doctoral students in the HMI Graduate School come from both Engineering sciences and from the Humanities. They are enrolled as regular graduate students in previously existing subject areas, such as for instance Computer Science, Industrial Ergonomics, Information Systems or Communication Studies. In addition to the study requirements defined by their respective area of study, students also have to meet requirements stated by the HMI School.

In order to qualify as an HMI doctoral student and to get the HMI School certificate after the PhD, the student has to take at least three quarters of a full year of courses from the HMI program, equally divided between method courses and subject area courses. In addition, the thesis project has to be approved by the HMI Graduate Study Board.

The students tend to take courses primarily in their home department, but over the years we have noticed an increasing interest in choosing courses both from other departments, and to a certain degree also from another University. The courses offered by the HMI School are usually designed to suit students with different backgrounds, but of course it is also important to observe the special knowledge background for students in each participating subject area and design courses accordingly. Thus, rather than giving all students the same training, the goals of an interdisciplinary study program are met by bringing students with different backgrounds and perspectives together, both in joint courses and in project work. An important and much appreciated part of the HMI program is the "summer school", where students are brought together once or twice a year, typically for about one week of intensive studies.

HMI Graduate School Challenges

The first challenge of the HMI Graduate School is to provide an effective interdisciplinary training environment for the doctoral students. As was mentioned above, this is done rather by bringing people together than by a specialised curriculum. However, the parallel ambition to connect different departments in different locations,

universities and cities, severely complicates the pursuit of this goal. Thus we have so far had limited success in reaching the goals of a large-scale interdisciplinary co-operation over a distance. But compared to the previous local PhD programs, the research school has achieved a significant increase in cross-subject co-operation between individual students and groups of students.

The creation of a joint course program involves the ambition to encourage students to take courses from other departments than their own, in particular to cross also borders of subject areas as well as faculties. In the beginning, students tended to prefer courses in their home departments, but over the years more and more students have come to use the opportunity to benefit from the full course offering of the HMI school.

For supporting courses over a distance, we are increasing the use of IT. So far, students or teachers have usually travelled between Stockholm and Linköping for lectures and seminars, while course information is managed over the internet. The video-conferencing infrastructure available has been used for some courses, but although the best modern technology is available in both places, the kind of interaction expected in a graduate course takes a lot of experience to achieve over a distance. Interestingly enough, the quality of the sound transmission has been a much more limiting factor than the video transmission.

THE INDUSTRY RESEARCH SCHOOL

The special Industry Research School program within the graduate school is sponsored by The Foundation for Knowledge and Competence Development, the KK Foundation, and a number of companies. It offers

- an industry-related, high-quality doctoral program which is based on and utilizes the special IT competence at Linköping University.
- an effective organization coordinated with the regular graduate study program and other strategic research efforts.
- a market-oriented and individually designed research education with extensive advisor capacity, leading to an exam as PhD, Licentiate or Master of Science.

Within the program, more than twenty industry doctoral students are trained each year in Software Engineering, Computer Science and Applied Information Technology. The subject areas covered by the school focus on engineering approaches to the design, development and maintenance of software systems in an industrial scale, as well as on methods and tools supporting software processes. There is a special emphasis on very large systems and their interaction with the individuals and organizations involved. Applications may concern real-time

systems, net-based information systems, user interfaces, IT services, etc.

Activities in the Industry Research School started in 1997 and doctoral students are recruited continuously. Areas studied include software architecture and support environments for software development, IT management, information system development, electronic commerce multi-modal user interfaces, usability engineering, requirements engineering, database technology, and intelligent agents. Companies active in the Industry Research School include both major multinationals such as Ericsson, Nokia, SKF and IKEA, as well as small and medium size enterprises.

The course program offers about thirty general courses each year in various areas, but there are also some courses arranged especially for the industry doctoral students, for example the course in industrial project management.

PhD students are recruited both directly from undergraduate education and from industry. Most of them has some industrial experience before joining the program and some have a rather extensive experience (in the order of ten years). Some doctoral students spend most of their time at the University, although with a close connection to their sponsoring company, while others do their thesis work more closely integrated in the industrial environment. Ideally, students in the Industry Research School should spend the initial part of their studies mainly in the university environment where they get their scientific training, while the thesis project can be carried out inside the company. Many of the industry doctoral students belong to companies in other cities than Linköping, and thus have a need to co-operate at a distance.

Managing Industry Doctoral Students

The real challenge in running the PhD program with industry-based doctoral students is to provide a solid scientific training, while at the same time accepting that only a limited time will be spent in the academic environment. In fact, the division of time between locations differs quite a lot. It depends on the type of research carried out and the level of research-related activities in the particular company, on the age and experience of the student, and on the distance between the place of living and the company/university.

The situation is further complicated by the difference in age and experience, with a range from newly graduated candidates to senior technicians with decades of experience. Obviously, the appropriate methods for bridging the distance differs a lot for these various categories. Composing the advisory committee with a combination of main and assisting supervisors, as well as creating smaller groups of co-operating doctoral students are important aspects on managing this problem. In particular, bringing

for instance young, university-based and more experienced industry-based doctoral students together promotes a valuable mix of theory and practice for the involved parties.

For supervision and courses conventional IT support is used in the Industry Research School without any particular sophistication. In fact, we believe that the interaction that takes place in the personal meetings in this connection is so important, that few initiatives have been taken to promote IT-based doctoral studies at a distance.

A general observation in connection with the Industry Research School, is the importance of the increasingly shorter time to market for knowledge in rapidly evolving areas such as Computer Science and IT in general. The effect of this is that fewer and fewer are motivated to complete an extensive university education before entering the business arena. The need for continuing education, all the way up to a PhD is at the same time rapidly increasing.

THE SATELLITE UNIVERSITY COLLEGE PhD STUDY NETWORK

A third area of challenges for Swedish PhD education, especially in the IT sector, is the increasing need to produce qualified applicants for faculty position in the new universities and university colleges recently created throughout the country. Due to the low mobility within the Swedish academic system, it is hard for the new universities without PhD programs to attract applicants from the established universities. For this reason, the new universities support students with a local MSc or teaching staff without a PhD degree to engage in doctoral studies at a distance. For instance, the Computer Science department at Linköping University has admitted between thirty and forty doctoral students employed by different university colleges.

In order to more systematically promote the examination of PhDs in the IT area with a high propensity for employment also at the new universities and university colleges, The Foundation for Knowledge and Competence Development (the KK Foundation) has initiated a national program, the IT Uplift program. This program, with a budget of about 25 MUSD over five years, includes the following actions:

- Funding of supervision networks, where a group of doctoral students from different departments are supported by a number of cooperating supervisors.
- Organization of a course program designed for studies at a distance, including ambulating courses.
- Interdisciplinary retraining, where candidates holding a PhD in a different discipline are offered a master's program in Information Technology, in order to qualify for faculty positions in the IT area. This initiative serves the dual purpose of producing additional PhDs with a competence in IT and to contribute

multidisciplinary experience to the receiving departments.

The IT Uplift will by necessity develop and produce new methods and technologies for supporting PhD-level education at a distance. This involves both regular courses and support for distributed seminars and supervision. However, since the IT Uplift is just put into operation, few experiences can be reported so far. In general, some university colleges will have local research groups of good quality, which can provide, at least in part, the necessary scientific environment needed for an effective PhD education. On the other hand, the networking model is even more interesting in those cases where single PhD candidates in a particular university college is connecting to the network. In this case, the situation and the needs are quite similar to those of the Industry Research School. The creation of research schools with national supervision networks on a broader scale is currently under discussion in Sweden.

DISCUSSION OF PROSPECTS AND CHALLENGES

Throughout the various graduate education programs discussed in this paper, we see a recurring pattern of the different levels of the IT support available:

- *Internet-based Communication and Information Management.* The basic level of IT-mediated communication is used as a fundamental resource in the obvious way.
 - *Video Transmitted Lectures and Meetings.* At this level more or less sophisticated technical solutions are available. For standard lecturing point-to-point, the state of the art is well established, but for more dynamic interaction much remains to be learnt.
 - *Computer-Based Learning.* Few tools and systems adapted to the needs of doctoral-level studies are available. So far, we have no experience worth mentioning in this area.
 - *Simulation and Experience-Based Training.* An important use of IT for learning is to use various kinds of simulation tools and model building. Although we have quite a lot of research in this area [3,4,5], this technique is still more appropriate for skills-based than for knowledge-based learning, and thus not so easy to apply in a PhD education program.
- *Computer-supported assessment and examination.* An area of special interest is the possibility to use IT support for on-line examination and other forms of student assessment and feedback. It appears that much remains to be learnt regarding these opportunities in graduate as well as undergraduate education.

A final observation about IT and the management of distributed PhD study programs, is that the task to an increasing degree will become distance education in both space and time. Not only will there be an increasing need for supporting PhD studies at a geographical distance, be it in co-operation with industry or regular academic endeavours, but also a need to meet the “shorter time to market” required for knowledge in rapidly developing areas such as IT itself, by offering well-planned continuing education up to the level of a PhD.

ACKNOWLEDGMENTS

The author of this paper acknowledges the important contributions of all the colleges in the HMI Graduate School, in particular Yvonne Wærn, Kjell Ohlsson and Kerstin Severinsson Eklundh. The administrator of graduate studies in the Industry Research School, Lillemor Wallgren, has been instrumental for all its success. John Furstenbach and Janis Bubenko have organized the IT Uplift on behalf of the KK Foundation.

REFERENCES

1. Ohlsson, K. and Severinsson Eklundh, K., Graduate School for Human-Machine Interaction. Organizational overview submitted to CHI-2000, The Hague 2000.
2. Wærn, Y., *Co-operative Process Management: Cognition and Information Technology*, Taylor and Francis, 1998.
3. Granlund, R, *C3Fire – A Microworld Supporting Emergency Management Training*, Licentiate thesis LiTH 598, Linköping University, 1997.
4. Ragnemalm, E, *Student Modelling Based on Collaborative Dialogue with a Learning Companion*, PhD dissertation LiTH 563, Linköping University, 1999.
5. Jenvald, J, *Methods and Tools in Computer-Supported Taskforce Training*, PhD dissertation LiTH 598, Linköping University, 1999.