

Graduate School in Information and Communication Technologies. Experiences at Tallinn University of Technology

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Abstract

During the last two decades Estonian higher education system has undergone great changes. It has been transformed from the rigid Soviet system to a modern European system that is guided by the Bologna process. Graduate (PhD) education system was rebuilt from scratch. These changes have had major implications and only recently Estonian graduate education system started to reach to these quality levels that are necessary to support the knowledge-based society. In this paper we will focus on one of the measures to increase quality of graduate education, namely graduate schools. We will describe Estonian Graduate School in Information and Communication Technologies, analyze the impact of this school to our graduate education and explain the problems and shortcomings.

1. Introduction

Modern educational reforms started in Estonia in 1991, after the collapse of Soviet Union. Since then Estonia has undertaken several extensive reforms with the aim of integrating Estonia into the European common space of education and research. Since 2000 the changes in the higher education area have followed the principles of the Bologna process, introducing new qualification structure and support mobility. The introduction of the accreditation process and adopting a system of accumulation of credit points had already taken place in pre-2000 period.

Probably the biggest changes have occurred in graduate (PhD-level) education. Until 1991 there was 2 graduate degrees. *Candidate of Science* studies normally lasted three years, included original research and publication, and the degree is comparable with modern PhD degree. The second stage of graduate studies lead to the degree of *Doctor of Science* that was a complement to a PhD degree [1]. The number of awarded degrees was relatively low and had high social status.

After 1991 the duration of undergraduate studies was extended from 5 to 5+2 years, by introducing 2 years of master studies. In 1998 this was reduced to 4+2 years. The graduates of master study program were awarded *Master* degree after the public defense of original research. The master degree was introduced as the first research degree in the higher education system and became a requirement for those who wanted to work in research institutes or higher education establishments, or to continue studies towards a PhD degree [2].

Today, doctoral studies constitute the highest stage of higher education with the purpose of acquiring knowledge and skills

necessary for independent research, development or professional creative work. Since 2002 the prerequisite is 3+2 years of undergraduate courses (180+120 ECTS points). The nominal length of doctoral studies since 2002 has been 4 years (240 ECTS points, 25% courses, 75% research)

2. Graduate Education in Information and Communication Technology (ICT) Areas

In pre-1991 era there were neither graduate curriculums nor experience at universities to work with PhD candidates, as PhD degrees were seen more as a result of a research work, and not so much connected to the studies. Different from USA, Germany, or Finland, where PhD degrees are rather common sight among R&D personnel or management, in Estonia the PhD degree was considered important only when one wanted to pursue his/her career at university research and to become ultimately a professor. In 1991 only 57 new students started graduate studies in the entire country and the first year when more than 10 new PhD degrees were defended was 1997 [3].

In ICT areas such lack of interest could partially be explained with Estonia's rather unique situation in using ICT at these times. Due to the stagnation of the Soviet system we had largely missed the technological developments of 70s and 80s. The computer resources were virtually nonexistent, but Estonia's proximity to the Nordic countries (Finland, Sweden) and many other reasons lead to a belief that ICT could be one of the cornerstones for rapid economical development. In retrospective it can be said that this belief was very correct.

As Estonia had very little legacy computer systems then ICT sector was open for rapid developments, consequently generating huge demand for skilled labor. Students were offered well paid jobs long before their graduation. Lot of knowledge was acquired independently, before these topics were even covered at university curricula. Such rapid growth devalued the importance of university diplomas and degrees – all that mattered were skills and experience. As a result, many students dropped out from the universities and graduate studies were one of the least prominent career choices.

Over the time the labor market started to change. The companies started to work with increasingly complex projects. First true high-tech design houses (in analog and digital, as well as in system design domain) were established. Many companies started to look for students with good quality university degrees. Several R&D companies started to request PhD degree as one of the pre-

requisites. Therefore, the interest towards graduate education started to increase as well. To ensure quality of graduate studies at Tallinn University of Technology (TUT), a modern graduate studies curricula, that was devised based on similar curriculums from Nordic, European and North American universities, was introduced in 1997. It was revised and modified in 2002.

3. Graduate School in Information and Communication Technologies (IKTDK)

Despite introduction of modern curricula the quality of graduate studies was still far from being adequate. One of the negative factors was already mentioned small number of graduate students. There were departments with very few graduate students and the “critical mass” was largely missing. This reduced the quality of the education as many courses had to be replaced with individual work, and gave students very little possibilities to interact with other graduate students. Very big responsibility was put on supervisors. Unfortunately, not all supervisors were able to support graduate students equally well. As a result, the efficiency of graduate studies was rather low. Many students produced almost no scientific results. The number of students that graduated during nominal study period was below 40%.

Graduate schools have been recognized in many countries as one of the possibilities to obtain high efficiency: high scientific quality and results by jointly using the best obtainable intellectual base and infrastructure with dedicated external funding. In general, the objective is to strengthen the graduate studies in some specific area and to increase the number of on-time defenses.

In 2005 Estonian Graduate School in Information and Communication Technologies (IKTDK) was launched. IKTDK is based on two universities that are providing graduate education in ICT areas in Estonia: Tallinn University of Technology and Tartu University. Additional partners are: Helsinki University of Technology and Turku Centre for Computer Sciences from Finland, Institute of Cybernetics, Cybernetica AS, and Estonian Association of Information Technology and Telecommunications from Estonia. The school is 75% financed in the framework of the Estonian National Development Plan from the European Union Structural Funds [4]. The remaining 25% is financed by the respective universities.

IKTDK is not a graduate school in a Nordic sense, where graduate schools have their own curricula and finance all aspects of graduate studies, including salaries of graduate students. IKTDK focuses on increased mobility of students and supervisors, internationalization, and joint courses in a form of summer schools. In autumn 2005 first 52 students were accepted and in autumn 2006 additional 17. The selection was made based on their previous results as well as on study plans.

IKTDK is currently financed as a 3 year project. During this period the plan is to support up to 250 conference visits (with prerequisite to have a publication), 150 weeks of graduate student visits to foreign research institutions and universities, but also to bring in guest lecturers, support co-supervision, summer and winter schools. Till now we have had 2 intensive courses and many shorter lectures (Daniel Foty, Tijn de Bie, Axel Jantsch, and many others). First annual conference, one summer and one winter school have been organized. For the annual conference all stu-

dents (de facto 70%) prepared a scientific paper, describing their original research work and made a 20 minutes long presentation. As graduate school covers students from two universities (that are geographically apart), then such setting offered many possibilities for interaction and joint discussions. Summer and winter schools brought to Estonia all together 9 prominent researchers, covering topics in computer science, systems science, software engineering, artificial intelligence, bioinformatics, and others.

From a student perspective the bureaucracy of the graduate school is reduced to a minimum and the requirements are very much the same as for any other university-financed visit. The decisions to finance one or another visit are made by a supervisor of the student together with the graduate school representative.

Despite many possibilities, that IKTDK offers, it has become clear that for many students the previous lack of critical mass and resources was only an excuse. Of all students in IKTDK only about 50% have actively used the resources, provided by the school. But for many students the IKTDK has been an additional motivator to write papers and go to conferences. Many students have actively taken part of the guest lectures and worked with their contacts abroad. This has strongly contributed to their progress and has been good motivating factor.

4. Conclusions

Without doubt, a graduate school is one of the best possibilities to improve the efficiency of graduate studies. One of the main problems with the current format is that it offers no possibilities to influence the curricula of the participating universities and has no formal means to influence the students to be more active, thus making the quality control very difficult. Therefore, there have been discussions at the national level to reform the schools similar to the Nordic graduate schools – having their own curricula, finances, and responsibility on quality.

The importance of the graduate schools has also been recognized also at the national level [5], as our number of graduates is far below the numbers in neighboring countries. In Nordic countries the number of PhD defenses per million people is ca 250-300. In Estonia the same number is ca 50 [3]. Therefore, our ambitions to become knowledge-based society can seriously be hampered and we are hopeful that in the future the graduate schools will have more prominent position in our graduate education system, contributing to the quality of the graduates, as well as being a motivating factor for taking up the studies and graduating on-time with high quality thesis.

5. References

- [1] Reviews of National Policies for Education, Estonia. *Organization for Economic Co-operation and Development (OECD)*, 2001.
- [2] Higher Education System in Estonia. *Estonian Enic/Naric Centre*. www.socrates.ee
- [3] Report of Phare Project “Development of Measures to Strengthen Doctoral Studies in Estonia.” V. Puura, T. Lehtsaar, A. Kämer (Eds.), *Tartu University*, 2004.
- [4] The Estonian National Development Plan for the Implementation of the EU Structural Funds - Single Programming Document 2004-2006. *Estonian Government*, 2004.
- [5] Knowledge-based Estonia. Estonian Research and Development Strategy 2002–2006. *Estonian Research and Development Council*, 2006.