Aspects on Student Attrition and Persistence in Finnish ICT Engineering Education

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Abstract

Topics dealing with delayed graduation and discontinuation of studies in higher education have frequently been in the headlines. Although similar problems are present all fields of education, engineering is one of the main areas of concern dealing with student attrition. Many reports indicate that roughly only a half of the students entering engineering education ever graduate. These types of figures are reality in many Finnish engineering degree programs as well, although significant differences between different programs exist. One of the rich flavors but also central challenges present in engineering education deals with the high level of heterogeneity among the incoming students. In this paper, the topic is approached by studying the student characteristics of the B.Eng. Degree Program in Information Technology at Turku University of Applied Sciences, Finland. The student cohorts that started their engineering studies 2003 and 2004 are analyzed. The goal is to study and understand how the individuals with different educational backgrounds succeeded in their studies and, accordingly, to contribute to the discussion on these topics in the engineering educators' community.

1. Introduction

Topics dealing with delayed graduation and discontinuation of studies in higher education have frequently been in the headlines during the past few years. The global recession has meant challenging times even in the public economy and, accordingly, issues like extension of the average length of working life have been widely discussed by political decision makers (see e.g. [1]).

Similar reasons seem to lead to student drop outs in the different branches of higher education all over the world. According to Liimatainen et al. [2] the most important reasons behind delayed graduation both in scientific universities and universities of applied sciences in Finland deal with working during the studies, lack of study motivation, psychological problems, and family-related issues. On the other hand, also variables like the student's age at the beginning of the studies, parents' educational background, and academic performance and success during the studies often appear correlating with student drop outs [3]. Also thoughts hindering the reaching of educational and career-related goals have been shown to correlate with drop out risk [4].

Although similar problems are present in all fields of education, engineering is one of the main areas of concern dealing with student attrition. Shuman et al. [5] reported that approximately only a half of the students entering engineering education ever graduate, and roughly a half of the drop outs take place during the first academic year. These types of figures are reality in

many Finnish engineering degree programs as well, although significant differences between different higher education institutes and programs exist. Less than 30% of the students who began their engineering studies at the Finnish universities of applied sciences in 1999 graduated within four years (240 ECTS credits), i.e. within the planned length of their studies. However, roughly 70% of these students had graduated after nine years of studies. The respective figures for health care and social services students were approx. 65% and 85%. [6]

In addition to student attrition, many engineering programs suffer from a low number of applicants. There are difficulties in attracting young people to engineering studies in whole Finland. However, also encouraging talented young students, especially women, to choose engineering and, finally, to graduate, is a global challenge. The topic is frequently discussed in the press as well (e.g. [7] and [8]). Although the correlation between the number of applicants and drop outs is not clear [6], finding the "right" students matters. For example, according to Ruottu [9] 28% of the drop out engineering students of Kemi-Tornio University of Applied Sciences in Finland had no credits at all. That is, they had not completed a single course before discontinuing their studies.

In general, the reasons behind student attrition in engineering education are largely the same present in other fields of education. Successful engineering studies require strong knowledge background, achievement of relatively good grades, and motivation [10]. Zhang et al. [11] utilized a multiple logistic regression model to test and estimate the relationships between student success and six different background variables representing students' demographic and academic characteristics. Their results show that high school grade point average and mathematical SAT (a standardized test for college admissions in the U.S.) scores positively correlated with graduation rates. A study by Xenos, Pierrakeas and Pintelas [12] reports gender, success in studies, student's age, family- and health-related issues, as well as simultaneous working as reasons behind student drop outs in Computer Science.

One of the rich flavors but also central challenges present in engineering education deals with the high level of heterogeneity among the incoming students. However, rather limited attention is paid to the potentially different needs of these students. In this paper, the topic is approached by studying the student characteristics of the B.Eng. Degree Program in Information Technology at Turku University of Applied Sciences, Finland. The student cohorts that started their engineering studies 2003 and 2004 are analyzed. The goal is to study and understand how the individuals with different educational backgrounds succeeded in their studies and, accordingly, to contribute to the discussion on these topics in the engineering educators' community.

2. Heterogeneous student base – learning and teaching challenge

Global and national challenges generate pressure on engineering educators, developers, and administrators. They must constantly seek ways to improve the quality of learning and teaching processes and the environment in order to be able to mentor students towards their future profession. Every student drop-out is always an indicator of failure and loss for the institution and its personnel, although the system on student attrition and persistence is highly complex.

One of the challenges present in engineering education deals with the high level of heterogeneity among the incoming engineering students. Students enter Bachelor's level engineering education in the Finnish universities of applied sciences with many different educational backgrounds. For example, the new students entering the Degree Program in Information Technology at Turku University of Applied Sciences typically represent three main categories. Usually approximately 1/3 of them have a vocational degree, 1/3 have completed the upper secondary school with the so called "short" course in Mathematics, and the remaining 1/3 enter the program with upper secondary school certificate with a "long" course in Mathematics. In addition, the students with vocational degrees often represent many different fields; usually technical or business-oriented, but also others. Although this study focuses on the Finnish context, even this challenge is also present elsewhere (see e.g. Reed [13]).

2.1 Do the students' mathematical background matter?

The mathematical knowledge and skills of students entering the program were studied in a research study by Tuohi, Helenius and Hyvönen [14]. The new engineering students completed the same test during the years 1999 to 2003. The results indicated significant differences in mathematical skills depending on the students' educational background. In addition, it was found that the mathematical skills of new students had significantly decreased during the period of the study – regardless of their educational background.

The goal of the degree program is to provide such an environment that the students have equal possibilities to learn and, finally, reach the same main learning objectives regardless of their educational background. However, there are rather limited possibilities to tailor the teaching and learning processes so that they fit the partly different needs of individual students or even the different categories.

In practice, the new students are currently divided into three different course groups based on their main educational background category. The courses provided are mostly the same for all three categories, but the groups enable the lecturers to tailor their methods, at least to some extent, depending on the group's background. These groups are maintained during the first and partly during the second year of studies. From the beginning of the third year the groups are mixed when the students select their specialization, and no specific attention is paid to the background of the students thereafter.

There are different opinions between the lecturers whether the current process is as good as it could be or, on the other hand, whether the educational background affects students' risk to drop out, or their possibilities to reach the learning objectives in the first place. There are no automatically collected statistics that would support a deeper understanding of this issue either. If the current situation was better understood, it could provide more solid facts for the discussion, and, most importantly, help to develop the curriculum and other processes further.

2.2 Research question and methods

The main objective of this study was to understand how students with different backgrounds currently proceed through and complete their studies in the Degree Program in Information Technology at Turku University of Applied Sciences.

This study was implemented using retrospective statistical analysis. When the students enter the degree program, their educational background (with certain details of their grades in their secondary education certificates) has been recorded since 2003. However, there is no database that would directly connect these details with the data dealing with the completion of the studies. Consequently, the exit-point data was manually acquired from the student register database student by student and then connected to the start-point data.

The student cohorts that started their engineering studies 2003 and 2004 were analyzed. The data was collected in January 2011, i.e. roughly 7½ respective 6½ years after the students in the cohorts began their studies. At that point of time, all the students in the 2003 cohort had either graduated or discontinued their studies, and there only was one student in the 2004 cohort still studying. The 2005 cohort was not included this study; at the point of data collection 13% of the students of that cohort were still studying.

Note that the students were handled based on their student register number. That is, there can be some students in the population that have for some reason first dropped out but then later on applied to the program again and continued their studies with a new register number. These cases are not visible in the data. Moreover, students that have transferred to another degree program within the same institution are considered as drop outs. That is, the drop outs are defined somewhat differently than in the Finnish governmental statistics but the figures used in

this study still give a good perspective when analyzing the program-level characteristics especially.

3. Result summary

3.1 Overall statistics

The numbers of discontinued, graduated and still studying students of the 2003 and 2004 cohorts categorized by the students' educational background are given in Table 1. Also the standardized mean grade point averages (GPA) of the students' secondary degree certificates in respective categories are given.

Table 1: Distribution of the educational background of the discontinued and graduated students (2003 and 2004 cohorts).

2003 cohort	All	Discontinued			Graduated			Still studying	
	#	#	%	GPA	#	%	GPA	#	%
Total	93	52	55,9 %	7,6	41	44,1 %	7,8	0	0
Vocational degree	28	14	50,0 %	7,5	14	50,0 %	7,8	0	0
Upper Secondary, short math	17	15	88,2 %	7,6	2	11,8 %	7,7	0	0
Upper Secondary, long math	48	23	47,9 %	7,6	25	52,1 %	7,8	0	0

2004 cohort	All	Discontinued			Graduated			Still studying	
	#	#	%	GPA	#	%	GPA	#	%
Total	96	53	55,2 %	7,7	43	44,8 %	7,8	1	1,0 %
Vocational degree	34	19	55,9 %	7,7	14	41,2 %	7,9	1	2,9 %
Upper Secondary, short math	23	12	52,2 %	7,6	11	47,8 %	7,6	0	0 %
Upper Secondary, long math	39	21	53,8 %	7,7	18	46,2 %	7,8	0	0 %

The statistics indicate that the final and near-final drop out rate is 56% and 55% in the 2003 and 2004 cohorts respectively. It can be asked if dropping out is independent on the educational background. There is no statistical evidence to answer no when the 2004 cohort data is considered. However, the 2003 cohort data shows that dropping out and educational background are dependent (Pearson Chi-Square 2- sided test, $p = 0,012$).

In addition, there seems to be a small difference in the mean GPA between the discontinued and graduated students. Considering the whole population (2003 and 2004 cohorts together) or the 2004 cohort separately this difference is not statistically significant. However, even in this sense the 2003 cohort differs from 2004. There is a statistically significant difference in the mean GPA between the discontinued and graduated students (independent samples 2-tailed t-test; $p = 0,024$).

Based on only these results it is difficult to make any further generalizations either considering the correlation between the students' educational background or their secondary education GPA and the drop out risk. However, the results advise that there is a difference between these two cohorts especially considering the drop out rate of the students that studied a short course in Mathematics in the upper secondary school. The fact that only two students out of 17 graduated indicates that something truly has happened. The reason behind this remains unclear. The 2003 and 2004 curriculums are almost identical, and most of the courses have been lectured by the same faculty members.

So far, the only difference found between the cohorts is how the first year students have been divided into course groups. In both cases the students with vocational background were

allocated to a separate course group. However, year 2003 most of the “long math” students were allocated to their own course group and the “short math” students, together with some long math students with lower grades, to a separate group. Instead, year 2004 the upper secondary school students were also placed in two different course groups but randomly without considering their previous course level or grades in Mathematics. Could it simply be possible that something happened in the 2003 group dynamics that finally led most of the upper secondary graduates with “short math” to choose other paths?

3.2 Point of discontinuation

Another interesting view is to analyze data considering the point of studies when the individual students have decided to discontinue their studies. Table 2 presents the number of credits the students had in their register at the point of dropping out. The results are displayed in credit intervals, i.e. indicating the number of drop out students whose number of credits fall into the given interval. Note that the extent of the B.Eng. degree program in Information Technology is 240 credits according to the European credit transfer system. The planned duration of studies is four years which means that a student progressing normally in his/her studies should gain 60 credits per academic year.

Table 2: The distribution of the educational background and the amount of credits (at the point of drop out) of the discontinued students in the 2003 and 2004 cohorts.

2003 cohort	Number of credits @ drop-out									
	0	]0, 5]	]5,10]	]10,30]	]30,60]	]60,120]	]120,180]	]180,240]	>240	Total (#)
Total (#)	*13*	*6*	*2*	*6*	*11*	*3*	*5*	*5*	*1*	*52*
Vocational degree	*1*	*4*	*1*	*2*	*3*	*0*	*3*	*0*	*0*	*14*
Upper Secondary, short math	*3*	*2*	*1*	*1*	*4*	*1*	*0*	*2*	*1*	*15*
Upper Secondary, long math	*9*	*0*	*0*	*3*	*4*	*2*	*2*	*3*	*0*	*23*
% - Total	25 %	12 %	4 %	12 %	21 %	6 %	10 %	10 %	2 %	

2004 cohort	Number of credits @ drop-out									
	0	]0, 5]	]5,10]	]10,30]	]30,60]	]60,120]	]120,180]	]180,240]	>240	Total (#)
Total (#)	*5*	*0*	*5*	*9*	*19*	*2*	*6*	*6*	*0*	*52*
Vocational degree	*1*	*0*	*3*	*2*	*11*	*0*	*0*	*2*	*0*	*19*
Upper Secondary, short math	*0*	*0*	*1*	*2*	*4*	*1*	*3*	*1*	*0*	*12*
Upper Secondary, long math	*4*	*0*	*1*	*5*	*4*	*1*	*3*	*3*	*0*	*21*
% - Total	10 %	0 %	10 %	17 %	37 %	4 %	12 %	12 %	0 %	

Even this perspective to student attrition and persistence in the degree program indicates both similarities and differences between the two cohorts. More than 70% of the students that discontinued their studies had 60 credits or less. That is, the first academic year (at least when considering the number of credits) is critical. Although small number of students discontinue throughout the academic years, most of the students seem to make their decision whether to proceed with their studies or not during the first year; rather many already during the first autumn semester.

The perhaps most visible difference between the cohorts is that the number of drop outs with no or just a few credits is much higher in the 2003 cohort. Every fourth drop out in the 2003 cohort did not complete a single course whereas only 10% of the drop outs in the 2004 cohort have a similar profile. There seems to be no obvious reason for this. Course group composition can hardly have caused this, and it should be fair to claim that the institution or program staff have had very limited influence on the phenomenon. Has the entrance examination somehow failed (at least) in 2003, or is there something else behind these figures? On the other hand, the final drop out rates of the both cohorts are still very close each other.

4. Discussion

In this paper, topics dealing with delayed graduation and discontinuation of studies in higher engineering education were discussed. The challenge was approached by analyzing the student cohorts that started their studies in the B.Eng. Degree Program in Information Technology at Turku University of Applied Sciences in 2003 and 2004 respectively.

The results advise that the previous findings indicating that only a half of the students entering engineering education ever graduate are valid in this case as well. Roughly 55% of the students did not finalize their studies. In addition, the first academic year seem to be critical concerning the risk of dropping out in this degree program, too. More than 70% of the drop outs in the both cohorts had completed less than one year's studies.

In general, no strong evidence supporting the hypothesis that the students' educational background, especially in terms of Mathematics, correlates with the risk to drop out was found. Based on this rather limited study, the students entering the degree program have rather equal opportunities to graduate regardless to their educational background. Yet, the analysis revealed interesting differences between the two cohorts which encourages performing further research to better understand the reasons behind these findings. Also the fact that so many students leave the program without completing a single course is worrying.

Attracting talented young people to engineering studies and guiding them to graduation and a successful professional career remains a great challenge. The engineering educators play a vital role in this process, yet also other factors steer the career-related decision making of the future generation.

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