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Why do students choose to study Information and Communications Technology?

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Abstract

It is a worldwide problem that although many students are highly interested in Information and Communications Technology (ICT), they do not study it at the higher education level, or if they do then many of them eventually dropout. We studied the reasons student candidates choose to study ICT, in order to gather data that can be used for improving future ICT recruitment and retention. During the admissions procedure to three higher education institutions in Estonia, 1,464 student candidates were asked what reasons influenced them to apply to Informatics or Information Technology. On average, 2.6 candidates competed per available position at the institutions. Qualitative content analysis was used to code the candidates' open-ended answers and resulted inductively in 14 distinguishable categories. The most frequent reasons for studying ICT were general interest in ICT, previous experience in the field, need for personal professional development, and importance of the field in the future. Interestingly, only a few candidates expressed as a reason the importance of high salaries. Chi-square analysis showed that candidates were accepted with higher probability if they found ICT to be suitable for them, or expressed good opportunities in the labour market. These results are useful for planning effective admission procedures to recruit ICT students.

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1. Introduction

Recent reports warn of decreasing interest among young people to study science, technology, engineering, and mathematics (STEM) in many countries (European Commission, 2007; OECD, 2008), even though these disciplines are regarded as vital for future economic growth. Therefore, it is urgent to collect scientific evidence

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to find interventions and approaches that can initiate youth interest in studying STEM, including Information and Communication Technology (ICT).

Today, European universities produce fewer than 150,000 computer science graduates every year (Hüsing & Korte, 2010). However, the ICT industry desperately needs highly skilled ICT practitioners, and Europe needs more young people to pursue ICT studies to supply future increases in demand (Hüsing & Korte, 2010). In Estonia, employment in the ICT sector is 1.5 times lower than the average of OECD countries, and there is a lack of 1,000 to 2,000 specialists in the ICT sector (Pärna et al., 2011). Moreover, ICT specialists are needed in Estonia to initiate economic productivity in diverse areas of work and to prepare enterprises for international investment (Pärna et al., 2011). A recent report on the Estonian ICT labour market forecasts a demand of up to 5,600 higher education ICT graduates, but notes that the current supply stands at 4,550 graduates (Jürgenson et al., 2013a).

In order to increase students' interest in ICT, interventions at the educational level should be developed. In Estonia, a majority of schools offer lessons in ICT, but there is a high variation in the quality and content. The effect of ICT lessons in schools may be one possible reason for students' interest in ICT, and thus it is important to ask student candidates what influenced their choice to study ICT. As a result of this situation, several initiatives in informal settings have been introduced, and some of these have found their way into formal education, either integrated with other subjects or as separate courses; e.g., elective courses such as robotics or computer programming. However, it is not confirmed scientifically if applied initiatives in ICT have influenced learners' behaviours and how these should be combined for designing new interventions and approaches based on a scientific evidence-based conception.

One general goal is to increase society's inclusion in the ICT sector by providing education that develops abilities to apply and develop ICT solutions but that also motivates people to continue their ICT-related studies at the higher educational level. Higher education is needed in the ICT sector; a study carried out in the USA (2000–2005) shows that the importance of bachelor's or higher-level degrees in most IT occupations has grown (Sum, Khatiwada, & Palma, 2007). Also, employees with higher education earn more within the same occupation (Sum, Khatiwada, & Palma, 2007). However, at the level of higher education, we are faced with another problem – a high dropout rate among bachelor's- and master's-level students. There is a competition for ICT-related curricula, but about one third of accepted students drop out during the first study year. Therefore, admission procedures for recruiting ICT students should be made more effective, so that accepted students are more likely to finish their studies and start working in the ICT field. The first step to begin this study requires gathering vital information from candidates applying to study ICT-related curricula. In the longer term, our ongoing goal is to observe the students who participate in this study to identify which of them finish their studies and which do not. That kind of information will help predict dropout in future years and make admission procedures more effective. This is why we need to describe candidate groups during admission.

Two research questions were formulated for this study:

(1) What reasons for studying ICT are expressed by student candidates?

(2) Which reasons are more frequently associated with the candidates who are accepted to ICT studies versus those candidates who are not accepted?

2. Methods

To collect data about the reasons for studying ICT, a question was formulated for applicants and asked during the admissions procedure using the Estonian Admission Information System (SAIS). SAIS (www.sais.ee) is a service for submitting electronic applications securely over the Internet when applying for study at Estonian universities, colleges, and vocational schools. The question asked was: *What are the main reasons that influenced you to apply to Informatics- or Information Technology-related curriculum?* In addition, other information about candidates' background was collected by SAIS, e.g., gender, university, and curriculum.

The data were collected during the July 2013 admissions process from three universities and from among seven different curricula: *Computer Science* and *Computer Engineering* curricula at the University of Tartu (UT);

Computer and Systems Engineering and *Business Information Technology* at the Tallinn University of Technology (TUT); and *IT Systems Administration*, *IT Systems Development*, and *Information System Analysis* at the Estonian Information Technology College (EITC). Together, these three higher education institutions graduate the vast majority of bachelor's and master's students in ICT in Estonia. However, one curriculum, Informatics at the Tallinn University of Technology, was left out because the candidacy already started before data collection.

Table 1 summarizes the application data in terms of number of applications, number of accepted applications, and the competition for positions at each of the three universities. EITC received the most applications (769) and had the largest competition – 4.55 persons per position. The reason that competition in EITC was much higher than others may be that curricula in EITC is more practical and that EITC also offers the opportunity to attend classes in the evenings. The mean competition for the three universities was 3.11 persons per position. However, many people apply to more than one university and/or curriculum (the total number of applications was 1,807 but the total number of candidates was 1,464). The universities together accepted 572 students, and thus the competition was actually 2.56 persons per position. This is less than the calculated mean of 3.11 in Table 1.

Table 1. Applications, acceptance, and competition at the University of Tartu, Tallinn University of Technology, and Estonian Information Technology College.

University	Number of applications	Number of accepted applications	Competition
Tallinn University of Technology	462	212	2.18
University of Tartu	576	200	2.88
Estonian Information Technology College	769	169	4.55
Total	1807	581	3.11

The written answers of candidates to the question about the reasons that influenced them to apply to ICT-related curricula were analysed using qualitative content analysis. Firstly, a coding schema of 14 categories was inductively developed based on the data. In the course of developing the coding schema, two raters specified the categories until it was possible to reach 80% accuracy in comparing the answers of two persons. It resulted in a list of 14 categories: (1) *interest* (interest about the ICT field or working in this field), (2) *necessary at work* (more knowledge or further education is needed for the applicants' current job), (3) *continuing studies* (candidate wishes to remain in the same field as before and continue studying it at a higher level), (4) *salary* (later it will be possible to earn a good salary), (5) *labour market* (many jobs or career opportunities), (6) *importance in the future* (the field in general is important/promising right now and for the future), (7) *field development* (the field has developed or is constantly developing), (8) *scholarship* (during the studies it is possible to receive a scholarship or other financial support), (9) *suitability* (according to earlier experience the person fits well in this field and can manage it very well), (10) *likeability* (the person likes this field and wants to commit to it (emotional point of view), (11) *personal development* (candidate wishes to develop himself or herself personally, a desire to study something), (12) *prior experience* (candidate has prior work experience or practise in ICT), (13) *self-realization* (self-realization, wish to do something important; or the field offers challenges), and (14) *other* (something else not mentioned in the other categories, e.g., role model, school reputation, curriculum, future prospects). Secondly, three researchers carried out the data analysis following the developed coding-schema. Thirdly, 150 randomly selected answers (11%) from the database were independently analysed by a second researcher to test for inter-rater reliability. This resulted in inter-rater reliability score of 0.79 (Cohen's Kappa).

Following this, descriptive statistics were used to obtain a general overview of the data. Chi-square analysis was used to relate the reasons expressed by candidates to study ICT to the acceptance or non-acceptance of the candidates into ICT programs.

3. Results and discussion

3.1. Reasons for studying Information and Communication Technology

People who applied to study ICT-related curricula at UT, TUT and EITC were asked what main reasons influenced their decision to apply. Fourteen categories were distinguished from the answers: (1) *interest*, (2) *necessary at work*, (3) *continuing studies*, (4) *salary*, (5) *labour market*, (6) *importance in the future*, (7) *field development, (8) scholarship, (9) suitability, (10) likeability, (11) personal development, (12) prior experience*, (13) *self-realization*, and (14) *other*. Most candidates expressed only one (40.8%) or two (37.2%) reasons why they chose to apply to the ICT field. Three reasons were expressed by 18.9% of candidates and four reasons by 4.3% of candidates.

The most popular reason to study ICT was *interest* (55.4%), which can be explained by a high intrinsic motivation of candidates. The second-most popular category was *other reasons*, which was expressed by 27.1% candidates, and included many different responses, such as role model, school reputation, curriculum, and future prospects. *Prior experience* was expressed by 17.8% candidates, *personal development* by 16.8%, *importance of the field* by 13.1%, *labour market* by 11.8%, *field development* by 9.4%, *like ICT* by 8.5%, and *self-realization* by 7.3% candidates. Less popular reasons were *continuing studies* (6%), *suitability* (4.4%), *salary* (3.3%), and *necessary at work* (2.8%). The least popular response was *scholarship* (only 4 candidates), which is seen as evidence of extrinsic motivation. Since *interest* was the most popular reason expressed, it would be helpful to investigate what causes interest and motivation towards ICT-related career choices. In addition, many candidates had prior experience in the ICT field. For future research, a useful area of study would be what kind of earlier experience accepted candidates had and how important the experience is while continuing their studies. It was interesting that *scholarship* and *salary* were expressed by only a few candidates, since ICT students are offered higher scholarships than students in other fields. Also, salaries in the Estonian ICT sector are comparatively higher than other sectors and 1.63 times higher than Estonia's average salary (Jürgenson et al., 2013b).

Unfortunately, the open-ended answers offered by most of the candidates did not specify if particular interventions applied in Estonia for increasing students' motivation and competencies in the field of ICT had significant influence on their choice of curriculum. Despite only a few candidates expressing *scholarship* as an important reason, it could be important later during their studies or relate to dropout. It is possible that *salary* and *scholarship* were unpopular answers because candidates wanted to self-report their 'good side' – the question was asked when they were still candidates and before a decision on acceptance was made.

Some statistically significant differences were found between male and female candidates. Most of the candidates were men – 1095 (75%) versus only 369 (25%) women. This is similar to the percentage of females in the Estonian ICT workforce, which is 22% (Jürgenson et al., 2013b). It was found that female candidates had a higher probability (45.3%) of being accepted than male candidates (33.9%). Research tends to show that boys have better technology skills than girls, that they spend more time on home computers, and that they often have more positive attitudes toward computers (Hargittai & Shafer, 2006; Imhof, Vollmeyer, & Beierlein, 2007; Kuhlemeier & Hemker, 2007). On the other hand, research shows that girls are more proficient in the use of ICT (Ritzhaupt, Liu, Dawson, & Barron, 2013). Therefore, female candidates who choose to apply to ICT-related curricula may be more motivated than male candidates, and this helps increase their probability for admission.

3.2. Reasons associated with accepted and non-accepted candidates

Relationship between the reasons expressed for studying ICT and the acceptance of candidates was studied. Only a few statistically significantly differences were found. Table 2 shows all the differences between accepted and non-accepted candidates (the statistically significant differences are shown in bold).

Table 2. Differences of reasons between accepted and non-accepted candidates (Chi-square analysis). Statistically significant differences are shown in bold.

Category	Number of candidates expressing a particular reason (% within the group)			Difference between the groups of accepted and non-accepted candidates	
	Accepted	Non-accepted	Total	χ^2	P
Interest	324 (55.8%)	487 (55.3%)	811 (55.4%)	0.043	>0.05
Prior experience	105 (18.1%)	156 (17.7%)	261 (17.8%)	0.039	>0.05
Personal development	98 (16.9%)	148 (16.8%)	246 (16.8%)	0.003	>0.05
Importance in the future	70 (12%)	122 (13.8%)	192 (13.1%)	0.978	>0.05
Labour market	**80 (13.8%)**	**92 (10.4%)**	**172 (11.8%)**	**3.763**	**<0.1**
Field development	**44 (7.6%)**	**94 (10.7%)**	**138 (9.4%)**	**3.901**	**<0.05**
Likeability	53 (9.1%)	71 (8.1%)	124 (8.5%)	0.519	>0.05
Self-realization	45 (7.7%)	62 (7%)	107 (7.3%)	0.271	<0.05
Continuing studies	34 (5.9%)	54 (6.1%)	88 (6%)	0.045	>0.05
Suitability	**35 (6%)**	**20 (3.4%)**	**65 (4.4%)**	**5.675**	**<0.05**
Salary	22 (3.7%)	26 (3%)	48 (3.3%)	0.776	>0.05
Necessary at work	18 (3.1%)	23 (2.6%)	41 (2.8%)	0.309	>0.05
Scholarship	1 (0.2%)	3 (0.3%)	4 (0.3%)	0.363	>0.05
Other	**138 (23.8%)**	**259 (29.4%)**	**397 (27.1%)**	**5.520**	**<0.05**
Total	572 (100%)	892 (100%)	1464 (100%)		

Of statistical significance ($p<0.05$) was that more non-accepted candidates expressed *field development* and *other reasons* for studying ICT. This means that those candidates who expressed the importance of fast development of the ICT field and several specifically uncategorized reasons were more likely to not be accepted. Marginal statistically significant ($p<0.1$) difference was found in the reason of good possibilities on the *labour market* – candidates who expressed this perspective were more likely to be accepted. Statistically significantly ($p<0.05$) more accepted candidates expressed *suitability* as the reason to study ICT. In addition, several insignificant associations showed a trend that personal reasons (*prior experience*, *self-realization*, *salary*, *necessary at work*) seem to be predict admission more often that general ones (*field development*, *importance in the future*).

4. Conclusion

The aim of this study was to determine the reasons for studying ICT expressed by student candidates, and how these reasons relate to the acceptance or non-acceptance of the candidates. Seven ICT-related curricula from three higher education institutions were included in this survey. In total, 1,464 candidates submitted 1,807 applications and 572 of them were accepted. The total competition was 2.56 people per position.

All candidates answered the following open-ended question: *What are the main reasons that influenced you to apply to Informatics or Information Technology related curriculum?* Fourteen different reasons were distinguished from the candidates' answers using inductive content analysis: (1) *interest*, (2) *necessary at work*, (3) *continuing studies*, (4) *salary*, (5) *labour market*, (6) *importance in the future*, (7) *field development*, (8) *scholarship, (9) suitability, (10) likeability, (11) personal development, (12) prior experience, (13) self-realization*, and (14) *other*. The most popular reason was *interest* – which shows that students are intrinsically

motivated to study ICT. Less common reasons were associated with external motivating factors, e.g. *scholarship* and *salary*.

In comparing accepted and non-accepted candidates, only a few differences were found. Non-accepted candidates more often expressed *field development* as a reason for candidacy. Accepted candidates more often expressed reasons such as that ICT was *suitable* for them and good possibilities in the *labour market*. Still, there was no statistically significant difference in most of the reasons candidates expressed. The reasons for candidacy are not taken into account by the universities when deciding who will be accepted into ICT curricula. Many students drop out of the ICT program during the first study year, and perhaps the reasons for candidacy are related to dropout. However, this hypothesis requires additional exploration in a longitudinal study with the same cohort of students.

We do not know if the reasons expressed by ICT candidates can predict the future behaviour of those students accepted into the ICT program. Therefore, this study needs further examination. For example, some students will drop out because of poor progress, employment opportunities, or because they lose interest. Perhaps it is possible to predict that kind of behaviour by asking for additional information during the application process. For further research, it could be useful to examine how students' interests change during their studies, and the subsequent effects on their careers.

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