

First-year dropout in ICT studies

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Abstract—There is high demand for qualified Information and Communication Technology (ICT) practitioners in the European labor market. In Estonia, the problem is not a low number of ICT students but a high dropout rate. The aim of this study is to find how it is possible to predict first-year dropout in higher education ICT studies and possibly to engage methods to decrease dropout rate. Data was collected from 301 first-year ICT students in Estonia who filled in a questionnaire at the beginning of the first semester and after the first semester. Additionally, some information was collected electronically during the admission process. The results showed that on average, 32.2% of the ICT students in Estonia dropped out during the first study-year. It was found that students who dropped out had lower scores in the state mathematics exam. This means that the score of the mathematics exam is one characteristic that can predict dropout during the first study-year. At the beginning of the studies there were not many differences in students' perception of their interest and how well the studies met their expectations. However, the answers received after the first semester showed some statistically significant differences between the students who dropped out during the first study-year and those who did not. Differences occurred, e.g., in the case of the following questions: how big their interest in ICT was, how well the studies met their expectations, how pleasant studying was for them, and how high they felt was the probability of them finishing their studies. It can be concluded that asking questions after the first semester gives information to universities as to who are about to drop out. Based on the information universities can support their students to retain them. The results support some factors that were found in literature to be important for avoiding dropout (e.g., motivation, earned credit points, prior studies, expectations), but in some cases the results of this study are different than the literature suggests (e.g., age, gender, working during studies, number of friends in the ICT field). It could be that these factors are not that important in influencing first-year dropout in ICT studies.

Keywords—dropout, higher education, ICT studies, retention

I. INTRODUCTION

The role of Information and Communication Technology (ICT) has increased rapidly in recent years in all economic sectors. However, a lack of labor workers with good ICT knowledge and skills is a worldwide problem. For example, in the European Union, the forecast in 2013 suggested that the unmet demand for ICT practitioners could rise to 481,000–1,685,000 by 2020 (according to different scenarios) [1]. Unfortunately, the number of computer science graduates in the European Union has been decreasing since 2006 [1]. In Estonia, the forecast suggests that by the year 2020, the number of higher education graduates needed in the ICT sector and other sectors of the economy will be between 6,661 and 8,456 [2]. If the number of ICT student positions in higher education does not change compared with the years 2010–2012, the

number of ICT graduates will be around 8,400 by the year 2020, which will probably meet the demand [2]. However, it is only the case if all students who start studies will finish as well. Dropout in ICT related curricula is a problem in many countries. The average student dropout rate for computer science students in Europe is at around 19% [1]. So the problem is not a low number of ICT students but a high dropout rate.

The number of student candidates in ICT is about 2.6 times higher than the number of student positions (in the year 2013) [3]. Still, many of the students who drop out will enter the labor market and, therefore, more and more ICT workers will not have a degree in ICT. This is why it is necessary to understand which characteristics of the candidates should be taken into account in order to avoid dropout. The dropout rate has been found to be the highest during the first year of studies [44]; therefore, it is important to start investigating first-year students. Preventing dropout is becoming increasingly important, since a higher education degree is valued in the ICT sector. A study carried out in the USA (2000–2005) showed that the importance of a Bachelor's or higher degree in most ICT occupations had grown [5]. Also, employees with higher education earned more within the same occupation [5]. Thus, it is more beneficial for students if they finish their studies in ICT.

The aim of this study is to collect data to find how it is possible to differentiate the students who dropped out and who did not drop out during the first study-year. The study starts with a literature review and continues with analyzing the collected data to find if it supports the literature or not

II. LITERATURE REVIEW

Dropout is a complex problem and there are many factors that could influence a person to drop out of higher education. Furthermore, dropout reasons cumulate individually [6]. This chapter gives an overview of the factors that have been found in literature to influence dropout at the higher education level. The literature overview is about dropout in general, not only about first-year ICT students.

A. Demographics

Student demographics are one factor that could influence dropout at the higher education level. This means, for example, gender, age, place of residence as well as marital and parental status. It has been found that male students exhibit a higher probability of dropping out [7]. Moreover, older men are more probable to drop out than younger men, while age is not important in women's dropout [8]. Besides students' age, it has

been found that students who enter university immediately after high school have a lower probability of dropping out [8]. Belloc et al. [7] found that students who reside in the same city in which the school is located are more likely to drop out and change the field of studies within the same institution. Marital and parental status has also been found to influence dropping out and stopping out (leave for less than a year but continue studies), but there are some differences between male and female students here [8]. On the one hand, married men are more likely to stop out of studies for a short period than men who are not married, but the probability of dropping out is lower than stopping out for a short period. On the other hand, married women are also more likely to stop out for a short period, but not significantly more likely to stop out than to drop out. Women with young children are more likely to drop out than to stop out and men with young children have a lower probability of dropping out [8].

B. Students' income

Students' income could influence dropout at the higher education level. Generally, students in upper classes are found to be less likely to drop out, while students with a very high income may be less motivated to finish their studies [7]. In Estonia, students in ICT studies also have an opportunity to get a larger scholarship than in other fields of studies, but only about 20% of the students receive the scholarship. It has been found that financial aids, loans and scholarships can lower the risk of dropout [4]. Also, if parents support their children financially, the parents' income influences students' income and through this, dropout, as well [4].

One way to increase one's financial income is to work during studies. However, this increases the probability of dropping out [9] because it is difficult to combine studies and work [10]. The more hours students work, the less time they have for studying, and therefore, the probability of dropping out will become higher [11]. The employer also has a role in working students' dropout. The employer is an important person in young people's life and his/her endorsement of school persistence can have an impact on students [9]. In a previous study in Estonia it was found that 8% of ICT students were already working in the ICT field when they entered a higher education institution and that the main reasons for working were financial situation and gaining work experience, important in the labor market [3]. Prior studies have shown that the number of working ICT students grows every year, so that even more students are working during the second and third study-year. It has been found that already at the beginning of their studies, students considered starting working – the students' perception of the mean probability of going to work while studying was around 57.7% in Estonia [3]. Furthermore, a study about students in different disciplines in higher education showed that working during the final year of studies increased the probability of finding a full-time job after graduation [11]. Thus, working during studies could be positive.

C. Performance in the University

During the first year, ICT students in Estonia and in many other countries learn basic subjects, such as mathematics and programming, which are important in further ICT studies.

Divjak et al. [12] showed that mathematics courses were difficult and posed an obstacle to retaining ICT students. Programming courses are also difficult for many students and, therefore, failure rates in such courses are quite high – based on a systematic literature review of introductory programming, the mean worldwide pass rate in an introductory programming course is 67.7% [13]. In Estonia, ICT courses are not compulsory for students at the general education level – different schools offer ICT courses with different content (e.g., programming or learning to use software, such as word processors) and some schools do not offer any ICT courses at all. So, most of the students have their first contact with programming in the university (in Estonia about 56%) where difficult programming courses may cause stress and dropout. It has been found that students with a lower performance (grade point average and collected credit points) have a higher probability of dropping out of the university [7], [8] and that college grade point average is the biggest dropout predictor [4]. Students' performance in high school could also influence dropout. If a student gets higher marks in high school, the probability of dropping out of higher education is lower [7]. Kinnunen and Malmi [6] found that one reason for computer science students' dropout was not spending enough time on their studies – they preferred doing something else; they did not book enough time for the course; the course was difficult and took more time than expected. Again – one reason why a student does not have time for studying could be high workload, which leaves less time for studies and influences academic achievement [14].

Additionally, some other education related factors could influence performance in the university and dropout. It has been found that if a student has plans above a Bachelor's degree, the probability of dropping out is lower [4]. Parents' education also has an effect on their children either receiving a higher education degree or not. If parents have a higher education degree, their children are less likely to drop out [8].

D. Motivation

One factor that may influence dropout in all disciplines is learning motivation [15], [16]. Learning motivation is a condition which activates behavior and gives it direction [17]. Motivation is one of the characteristics which influence how students approach their learning [18]. Motivation is important in academic achievement – higher motivation results in higher academic achievement [19]. Bruinsma [19] found that students who had higher motivation in terms of expectancy earned more credit points at the end of the first and the second study-year. Furthermore, higher motivation can lower dropout rates [20]. Kinnunen and Malmi [6] found that one reason for dropout was lack of motivation, meaning that students did not have study motivation in general; payoff was unbalanced and motivation dropped; or some parts of the course were difficult and as a result, motivation dropped.

According to the Self-Determination Theory [21], motivation can be divided based on the different reasons that give rise to an action. In general, motivation can be divided into intrinsic motivation and extrinsic motivation. Intrinsic

motivation means that a person does something because it is inherently interesting or enjoyable; extrinsic motivation means that a person does something because it leads to a separable outcome [21]. Abar et al. [22] investigated high school students and found that the motivation type for attending school was associated with academic achievement and late high school dropout. One more motivation type can be added to intrinsic and extrinsic motivation – amotivation. Amotivation means that a person is lacking intention to act [23], which may cause dropout [15]. In this study, these three motivation types and their subcategories [24] are under investigation to find out if the motivation type influences dropout in ICT studies.

E. Social integration

It has been found that dropout is influenced by how social students are. Duque [25] found that student involvement influenced dropout. The involvement includes energy devoted to studies, time spent on campus, active participation in student organizations as well as interaction with faculty members and other students. Also, students with a higher level of academic or social integration are at a lower risk of dropping out [4]; college environment could cause stress and thus influence dropout [26].

Social factors influence students' psychology. It has been found that the more satisfied the student, the less likely he/she will drop out [25]. Also, stress in the college environment [26] and emotional exhaustion, part of the burnout syndrome, could influence dropout [25]. In addition to social factors, performance in the university could cause stress or satisfaction and thus influence dropout. Students' satisfaction is also influenced by the perceived quality of education and prior expectations [25].

F. Institutional characteristics

Another factor that could cause dropout is institutional characteristics, including student demographics, institution structure, faculty and finances [4]. In the case of student demographics, it has been found that students who drop out are more likely from institutions with a higher percentage of minority students [4]. When considering the institution structure, the students who drop out tend to come from public institutions and low-selectivity institutions [4]. The faculty also has an effect on dropout: the students who drop out are more likely from institutions with a lower full-time faculty-student ratio and a smaller number of full-time students [8]. Moreover, students in institutions with a higher level of expenditure on student services exhibited a lower probability of dropping out [4].

Different factors can be found in literature that could influence dropout at the higher education level. However, we do not know if and how these factors influence dropout in ICT studies. Also, there could be some ICT specific factors that influence dropout in this field. This study will try to find out which factors influence dropout in higher education ICT studies during the first study-year.

A. Participants

This study involved ICT students at three Estonian higher education institutions who started their studies in school year 2013/2014. They started their studies in Estonia at three higher education institutions and in eight different ICT related curricula. Together, these three higher education institutions graduate the vast majority of ICT students in Estonia.

The total number of ICT students at the three higher education institutions where the data was collected was 783, of whom 517 filled in a questionnaire at the beginning of the first semester and 489 after the first semester. The number of students who responded to both questionnaires was 301. 72% of the respondents were male and 28% female – this is similar to the gender distribution in ICT studies in Estonia, where about 25% of the students are female [3]. The average age of the students at the beginning of the first semester was 20 (the youngest student was 18 and the oldest 43). In Estonia, the person who finishes high school is usually 18–19 years old. So, most of the students who filled in the questionnaire started their ICT studies the same year they finished high school (73%). 6% of the students were already working in the ICT field. The average age of the working students was 21.9 years, which was slightly higher than the average age of the students who were not working.

B. Data collection

Three different types of data were collected: (1) before studies during the admission process by a question in the electronic admission system about the reasons for applying for ICT related curricula; (2) during studies through questionnaires about students' opinions about their studies; and (3) after studies from the universities' student information systems about students' progress and dropout.

During the admission process data was collected from all ICT student candidates. The Estonian Admission Information System (SAIS, www.sais.ee) was used for data collection. SAIS is a service for submitting electronic applications securely over the Internet when applying for studies at Estonian universities, colleges, and vocational schools. The candidates were asked the open-ended question "What are the main reasons that influenced you to apply for an informatics- or information technology related curriculum?" It was hypothesized that differences in the reasons might have some influence on students' progress and probability of dropout. This hypothesis derived from the fact that in previous studies, the motivation type had been found to be associated with academic achievement and dropout [22]. In addition, background information was collected about students' gender, last school where they studied, results of the mathematics state exam, as well as universities and curricula they applied for. This information was important for characterizing the population.

During the studies data was collected by using two questionnaires: (1) at the beginning of the first semester and (2) after the first semester. The aim of the questionnaires was

to understand how students describe their learning experience and motivation, previous experience related to ICT, reasons for studying, their knowledge about the studies in their curriculum, and plans for the future. The questionnaires were filled in by the students during their courses. Thus, the students who were not attending the face-to-face studies could not fill in the questionnaire. The possibility of responding to the questionnaire electronically was offered to these students, but this option was used rather seldom (less than 5% of the sample answered electronically).

Additionally, information about which students dropped out during the first study year and information about students' academic achievements was collected from the universities' student information systems. Academic achievement stood for students' grade point average and number of collected credit points. Information about academic achievement was collected because studies had shown that it might influence dropout [4].

C. Instruments

The question presented to student candidates during the admission process was formulated by a group of experts in ICT education. Seven group members had extensive experience in teaching ICT students at three different universities. Four members were experienced in teaching students at school. This helped to ensure content validity and appropriate wording of the question.

The questionnaires used during the studies were designed based on data collection during the admission process and discussions with the same experts who were involved in designing the question for admission. Some questions were asked in both questionnaires to collect longitudinal data and some questions were specific to the questionnaire. In this study, answers to the following questions were found important in determining dropout behavior: (1) How large is your interest in ICT? (2) How well does the curriculum meet your expectations? (3) How well do your studies (lecturers, teaching methods) meet your expectations? (4) How high is the probability that you will finish your studies? (5) How high is the probability that you will start working in the ICT field after finishing your studies? (6) How pleasant are your university studies compared to high school studies? It was hypothesized that these aspects might influence progress and dropout. Expert discussions were organized to validate the questionnaires.

One unique part of the questionnaire filled in after the first semester was Academic Motivation Scale (AMS-C 28) College (CEGEP) version [27]. The scale contained 28 items and the students were asked to indicate to what extent each of the items corresponded to the reasons why they started higher education studies. They assessed the items on a 7-point Likert scale: 1 – does not correspond at all; 2 – does rather not correspond; 3 – corresponds a little; 4 – corresponds moderately; 5 – rather corresponds; 6 – corresponds a lot; 7 – corresponds exactly. The scale helps to determine 7 constructs of motivation. The scale had been validated in former studies [28] and found to be reliable [29]. In this scale intrinsic and extrinsic motivation is both divided into three subcategories, amotivation being the seventh category [27]. Intrinsic motivation is divided into intrinsic motivation to know, intrinsic motivation toward

accomplishment, and intrinsic motivation to experience stimulation. Extrinsic motivation is divided into identified extrinsic motivation, introjected extrinsic motivation and external regulation. In Table I, these seven motivation types have been explained. The Academic Motivation Scale was selected for the current study as it had been used widely and had already been adapted into Estonian. Several authors [18], [19], [20] have shown that type and level of motivation could influence academic achievement and dropout and, therefore, it was important to understand students' motivation in our study as well.

D. Data analysis

Data analysis was started by categorizing all open-ended answers of the admission question and questionnaires filled in during the studies. A coding schema of categories was inductively developed by two researchers. To develop the coding schema, the researchers specified the categories until it was possible to reach 80% of accuracy between two persons. Then they carried out the data analysis following the developed coding schema, and 10% of randomly selected answers were analyzed by each of them independently to test inter-rater reliability. This resulted in a score higher than 0.8 (Cohen's kappa) in the case of all the answers to open-ended questions.

Data analysis for detecting differences between students who dropped out and those who did not was done by comparing the results of the two groups. Independent samples T-test was used to compare the answers of the students who dropped out during the first study-year and those who did not. Information as to whether the student dropped out or not was available only about two higher education institutions (204 students). Data about the third higher education institution was only used in describing the general behavior of dropping out.

TABLE I. SEVEN MOTIVATION TYPES (BASED ON [21], [23], [24])

Motivation type		Explanation
Intrinsic motivation	to know	person wishes to learn and get new knowledge
	toward accomplishment	person wishes to accomplish something
	to experience stimulation	person does something because it is satisfying and gives a good feeling
Extrinsic motivation	identified	person accepts the regulation because the activity is judged as valuable/useful and fits their value system
	introjected	person performs an action out of obligation to avoid anxiety, shame, and pressure
	external regulation	person acts to satisfy an external demand or obtain an external reward contingency, the locus of control is purely external
Amotivation		person has a lack of motivation

IV. RESULTS AND DISCUSSION

A. First-year dropout rate

The results showed that on average, 32.2% of the ICT students who started their studies in 2013 dropped out during the first study-year. The dropout rate varied slightly in different higher education institutions. The average dropout rate was 25.5% in the first higher education institution; 33.2 in the second; and 35.8 of the first year students dropped out in the third. The average dropout rate for computer science students in Europe is 19% [1], but the results of this study show that in Estonia the dropout rate is much higher already during the first study-year. Therefore, it is necessary to find out how to prevent dropout in ICT studies and how to predict which students will drop out in order to support them or to increase the effectiveness of the admission procedure by accepting those students who have a higher probability of graduating. Not only in ICT but also in other disciplines the risk of dropping out is the highest during the first year of studies [4], so the dropout rate will probably be lower during the next years.

B. Admission process

Mathematics is an important subject in ICT studies and therefore, students' scores in the state mathematics exam are usually collected during the admission process. In this study the scores were divided into five categories: (1) 0–20 points; (2) 21–40 points; (3) 41–60 points; (4) 61–80 points; (5) 81–100 points. The T-test showed a statistically significant difference in the exam results of the students who dropped out during the first year and those who did not ($p < 0.01$). The average mathematics exam score of the students who dropped out was 3.3 and the score of the students who did not drop out was 4.2. This means that the score of the mathematics exam is one characteristic that can predict dropout during the first study-year. Mathematics and programming courses are an important part of the first year in ICT studies. Other studies have shown that mathematics courses are difficult and an obstacle to retaining ICT students [4].

Reasons why student candidates wanted to study ICT were asked during admission because it was expected that reasons for studying could influence dropout. However, there were no statistically significant differences between the students who dropped out during the first year and those who did not. Both students answered that the main reasons for studying ICT were interest, prior experience and personal development that the field would offer [3].

C. Data from questionnaires

1) Questions at the beginning of the first semester

At the beginning of studies, i.e. the first semester, there were not many differences between the answers of the students who dropped out during the first year and those who did not. There was no statistically significant difference in age; gender; working in the ICT field during studies (however, we do not know about working in other fields); starting university studies immediately after high school or later; and the number of friends students have studying or working in the ICT field. However, the students who dropped out answered at the beginning of studies that the probability of them working in the

ICT field after finishing was lower than the students who did not drop out ($p < 0.01$). The students who dropped out answered, on average, that the probability of them working in the ICT field after finishing was 71.4% and the students who did not drop out answered that the probability was 87.3%. It was also assumed that students' perception about finishing studies could also predict dropout, but at the beginning of the first semester there were no differences in the probability of finishing studies (average 88.1%). Moreover, there were no differences in the probability of working during studies (average 54.6%) which could cause dropout because working students have less time for studying [11].

2) Questions after the first semester

The answers after the first semester showed some statistically significant differences. Table II sums up the questions that showed statistically significant differences between the students who dropped out during the first study-year and those who did not. The students who dropped out during the first year evaluated their interest lower than the students who did not drop out ($p < 0.05$). Also, the students who dropped out answered that the curriculum ($p < 0.01$) and the studies (teaching methods, lecturers, etc.) ($p < 0.05$) met their expectations less than the students who did not drop out. Moreover, after the first semester, the students who dropped out evaluated the probability of finishing their studies ($p < 0.01$) and working in the ICT field after finishing ($p < 0.01$) to be lower than the students who did not drop out. The probability of working in the ICT field after finishing was lower for the students who dropped out already at the beginning of studies,

TABLE II. STATISTICALLY SIGNIFICANT DIFFERENCES AFTER THE FIRST SEMESTER BETWEEN THE STUDENTS WHO DROPPED OUT AND THOSE WHO DID NOT (ON A 5-POINT SCALE)

Question	Mean of students who dropped out	Mean of students who did not drop out	t	p
How large is your interest in ICT?	3.7	4.2	-2,558	<0.05
How well does the curriculum meet your expectations?	3.1	3.8	-3,571	<0.01
How well do your studies (lecturers, teaching methods) meet your expectations?	3.3	4.0	-2,252	<0.01
How pleasant are your university studies compared to high school studies?	3.2	4.0	-3,350	<0.01
How high is the probability that you will finish your studies?	3.3	4.6	5,069	<0.01
How high is the probability that you will start working in the ICT field after finishing your studies?	3.7	4.5	-3,237	<0.01

but after the first semester, the probability of finishing was lower as well and they already might have considered dropping out. Also, students who dropped out evaluated the university studies to be less pleasant compared to students who did not drop out, but there were no differences in how difficult the university studies were for students.

3) Motivation

Some differences were found in the motivation of students who dropped out and those who did not (see Table III). The students who dropped out were less motivated to study. The mean amotivation score of the students who dropped out was 3.6, while the same score was lower, 1.7 ($p < 0.01$), for the students who did not drop out. Vallerand and Bissonette [11] came to a similar result: they found that students who had a

higher score in amotivation would drop out with higher probability [15]. Also, there was a statistically significant difference in one subcategory of intrinsic motivation. The students who did not drop out had higher intrinsic motivation to know – their mean was 5.2, whereas the mean of the students who dropped out was 4.6 ($p < 0.05$). This indicated that students who did not drop out studied more because they wanted to get new knowledge. Moreover, marginal statistical differences ($p < 0.1$) were found in one subcategory of extrinsic motivation – identified extrinsic motivation. The students who did not drop out had a higher mean score here (5.5) than the students who dropped out (4.9). This means that the students who did not drop out studied ICT at the higher education level more because they found ICT studies to be valuable.

TABLE III. DIFFERENCES IN THE MOTIVATION OF STUDENTS WHO DROPPED OUT AND THOSE WHO DID NOT

Motivation type		Mean of the students who dropped out	Mean of the students who did not drop out	t	p
Intrinsic motivation	to know	4.6	5.2	-2.093	<0.05
	toward accomplishment	4.9	5.0	-0.449	>0.05
	to experience stimulation	4.1	4.1	0.45	>0.05
Extrinsic motivation	identified	4.9	5.5	-1.971	<0.1
	introjected	4.4	4.6	-0.468	>0.05
	external regulation	5.0	5.3	-0.904	>0.05
Amotivation		3.6	1.7	5.782	<0.01

D. Academic achievement

The students who dropped out collected less credit points during the first semester than the students who did not drop out ($p < 0.01$). The average sum of the credit points collected during the first semester by the students who did not drop out was 31.5, whereas in the case of the students who dropped out, the average sum of collected credit points was 25.5. In full-time studies, the universities require collecting 30 credit points in one semester. So, the students who dropped out did not, on average, collect enough credit points. It has been found that the average grade is one factor that influences dropout [4]. However, the results of this study do not show a statistically significant difference in the first semester average grade of the students who dropped out and those who did not. Additionally, it was found that the students who had learned programming before entering university had a higher average grade ($p < 0.01$) than those who had their first experience of learning programming at the university. This is important because first-year academic achievement can predict future dropout – the students with lower academic achievement are more likely to drop out [30].

E. Dropout model

Based on the factors influencing dropout found in literature and the results of this study, it is possible to draw a dropout model (see Fig. 1). Dropout behavior is located in the center of the figure, surrounded by different factors that could influence that kind of behavior; the factors have arrows that point towards dropout. According to the model, seven types of factors could influence dropout: (1) student demographics; (2)

income; (3) motivation; (4) performance in the university; (5) the student's psychological condition; (6) institutional characteristics; (7) year of studies.

Demographics, year of studies and institutional characteristics influence dropout directly. Other factors are more related to each other. Students' income could be influenced by their parents' income and working during studies; the employer also has an effect on working students. Working does not only influence students' income but their performance in the university as well – the more hours students work, the less time they have for studies [14]. In addition, students' performance in the university could be influenced by their prior studies, educational plan, parents' education, and motivation. Motivation and performance in the university influence each other. On the one hand, if students are more motivated, they study more and their performance in the university improves; on the other hand, if students' performance in the university is poor, it could lower their motivation or, if students' performance is good, it may increase their motivation to study. Students' psychological condition (stress, satisfaction, emotional exhaustion) could again be influenced by their performance in the university. If the grades are good, the student is satisfied, but poor grades may cause stress. The psychological condition is also influenced by the perceived quality of education, prior expectations and social integration. If the relations with other students and the institution are good, the student is satisfied; however, having problems in the relations may cause stress and emotional exhaustion.

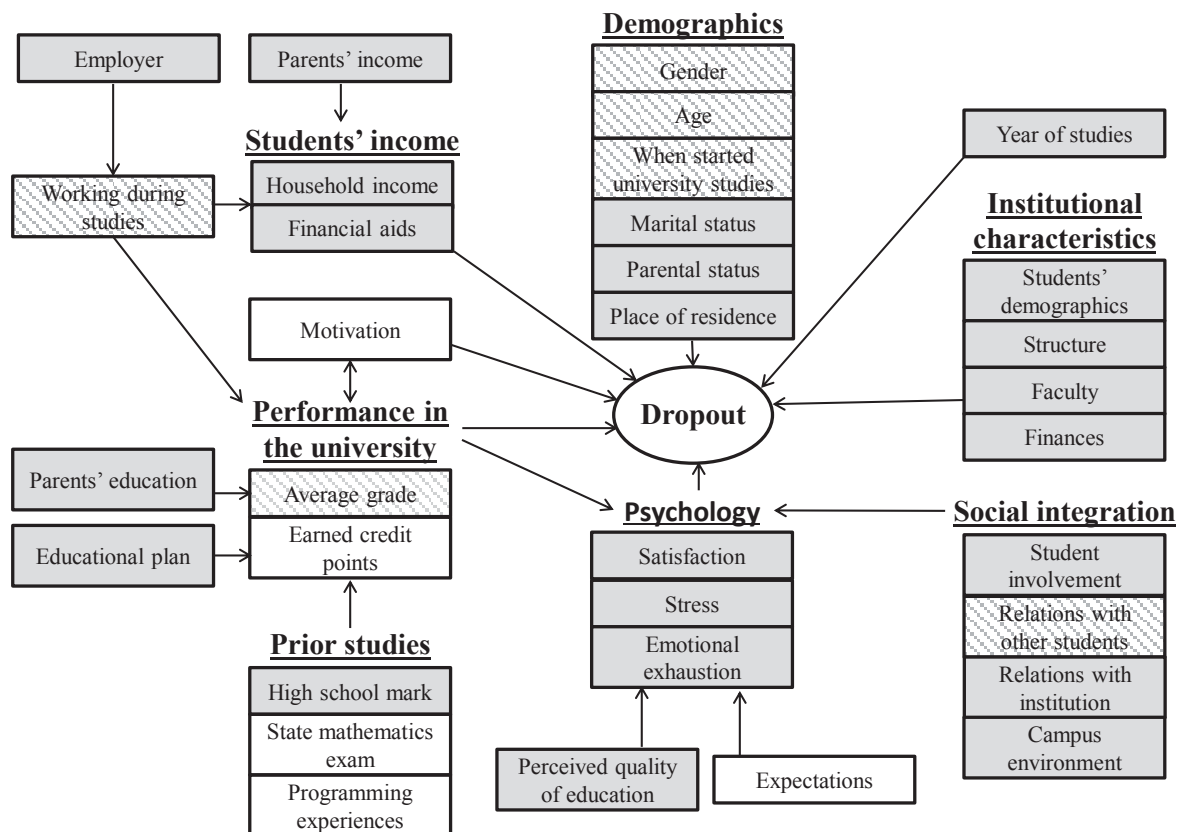


Fig. 1. Factors that influence dropout at the higher education level

In the figure, the white boxes are the ones that our results support and the striped boxes are the ones that influence dropout based on literature but which our data did not support. The factors that did not get support from our data were age; gender; time of starting ICT studies (immediately after high school or later); working during studies; average grade; and relations with other students. We did not find that these factors influenced dropout in the first study-year, but it is possible that these factors are more important in future dropout. Therefore, it is necessary to collect data from the same students in the following years to see if these factors are important in predicting ICT students' dropout. The gray boxes in the figure show the factors that could influence dropout, but we did not have data about it and did not measure it in this study. Future data collection is necessary here as well.

Some of the factors in the model are more student-centered and not much can be done by others to influence student retention through these factors. The factors that are difficult to influence are demographics; expectations; prior studies; educational plan; and year of studies. Some factors could be influenced by higher education institutions in order to retain their students. Institutional characteristics could be changed by institutions, e.g., how to use the finances [4]. Higher education institutions can also support integration between students and faculty members. Different events can be organized where

students can get to know each other better and communicate more with the faculty members outside the classroom. One reason for dropout could be that students do not see that the education they receive is of quality. Therefore, institutions could show more that they offer high quality education and change the curricula so that they would better meet the students' expectations. Institutions can also influence students' motivation – they can try to motivate their students extrinsically (offering rewards, scholarships) or try to show why the education is important for students and show what interesting can be done with ICT. It has been found in a prior study that the main reason for working during studies is financial situation [3]. Scholarships can be offered by the institutions to increase students' income; as a result, students would not have to work that much and would have more time for their studies.

In addition to higher education institutions, some support is needed from employers and parents to retain students. The dropout rates could probably be lower if the employers hired students with a lower workload and valued a higher education degree. Parents have also an important role in influencing students. The dropout rates could be lower if parents tried to support their children as much as they can (financially and psychologically) and valued a higher education degree.

V. CONCLUSION

Lack of labor workers with good ICT knowledge and skills is a worldwide problem. In Estonia, the problem is not a low number of ICT students but a high dropout rate. The results showed that already during the first study-year 32.2% of the students dropped out. Therefore, it is necessary to find out how to predict which students will drop out and which will finish their studies.

The following factors were found to influence dropout: (1) student demographics; (2) student income; (3) motivation; (4) performance in the university; (5) student's psychological condition; (6) institutional characteristics; (7) year of studies. Some of the factors are more student-centered, but some can be influenced by higher education institutions, employers and parents who can help prevent dropout in ICT studies. The results support some factors that were found in literature to be important in avoiding first-year dropout in ICT studies. These factors were motivation, earned credit points, prior studies, and expectations. In some cases the results of this study are different than the literature suggests (e.g., age, gender, working during studies, number of friends in the ICT field). It could be that these factors are not that important in influencing first-year dropout in ICT studies. However, they could be important in later years. Data about all the factors that could influence dropout were not collected in this study and therefore, further studies are needed.

ACKNOWLEDGMENT

This research was supported by the European Union through the European Regional Development Fund. It is financed in the project "Conceptual Framework for Increasing Society's Commitment in ICT: Approaches in General and Higher Education for Motivating ICT-Related Career Choices and Improving Competences for Applying and Developing ICT".

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