Integration of Estonian Higher Education Information Technology Students and Its Effect on Graduation-Related Self-efficacy

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Abstract. Low graduation rates in higher education are problem in many countries. This study investigates Estonian higher education IT studies, where focus is on interaction with computers, but first-year dropout rates are very high. The aim of the study was to establish which factors influencing dropout based on the literature are associated with each other, and according to Tinto's dropout model, to investigate the role of academic experience and social work-related experience in first-year IT students' graduation-related self-efficacy. Data were collected from 509 Estonian first-year IT students. The initial model shows that bivariate association found in the literature give a simplified impression of the graduation-related self-efficacy. Although Tinto's model can be implemented in first-year IT studies, IT work experience has a much greater effect on the graduation-related self-efficacy than academic experience. This means that working in IT field is very important for students in Estonian IT curricula and universities should take this into account.

Keywords: Academic experience · Graduation-related self-efficacy · Information Technology · Social experience · Work experience

1 Introduction

1.1 Dropout Rates

Substantial dropout rates in higher education are a problem worldwide. This study focuses on the graduation in Information Technology (IT) related curricula in higher education. The curricula focus on interaction with computers, which requires digital competence from the students. The European average dropout rate in higher education is 19% in the IT field [1]. However, in Estonia about two thirds of undergraduate IT students do not finish their studies (authors' calculations based on [2]). This exceeds the European average dropout rate in IT as well as other fields of studies in Estonia, where 46.1% of the students drop out (authors' calculations based on [2]).

In general, dropout rates are the highest during the first year of studies [3]. Among the students who entered undergraduate IT studies in Estonia in 2013, the first-year dropout rate was 32% [4]. The authors' calculations based on data from the Estonian Education Information System [2] show that the general first-year dropout rate in IT studies is 29.8%. This means that half of the students who drop out during their three years of

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undergraduate studies do so during the first year. Figure 1 demonstrates that dropout rates in the Estonian IT curricula are higher than in other curricula. The first-year dropout rate in other fields of studies is only 18% in Estonia (authors' calculations based on [2]). The first year of studies is crucial for students, and it is therefore important to investigate first-year dropout in IT curricula.

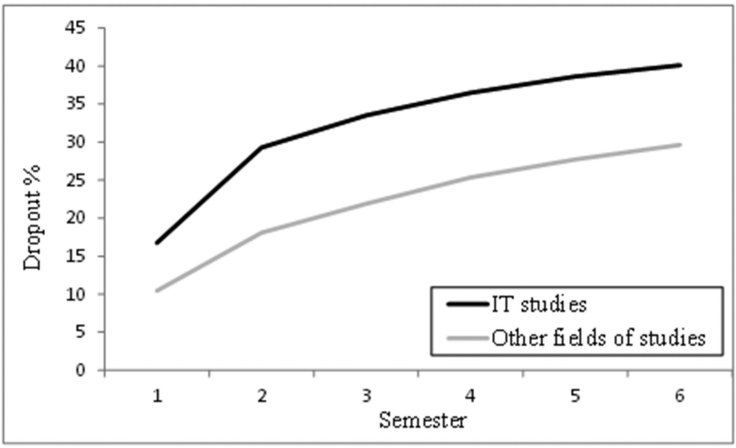

Fig. 1. Comparison of cumulative dropout rates during three years of undergraduate studies between IT curricula and other curricula in Estonia (authors' calculations based on EHIS, 2015).

1.2 Dropout as a Process

According to Tinto [5], dropout can be defined in two ways: (1) referring to students who leave the higher education institution in which they are currently studying and it is not known if they continue studies later in a different curriculum or different institution; or (2) referring to students who leave the higher education institution and will never receive any degree. A study in Australia revealed that if they followed the first definition then after the first study year 20% of the students were not studying in the same university, but the rate of students who actually did not study on the higher education level (the second definition) was less than 10% [6]. So, many students who drop out of a particular higher education curriculum probably continue their studies later in a different institution or different curriculum.

High dropout rates become a problem if the insufficient proportion of graduates with digital competence fails to meet the needs of the labor market. This is happening right now in the IT field: the number of IT graduates has been decreasing since 2006 in the European Union [7], and forecasts suggest that the unmet demand for IT practitioners keeps rising. According to different scenarios 913,000–1,300,000 IT workers could be missing by the year 2020 [7]. Thus, more IT graduates are needed in the labor market.

There is a demand for people with good digital competence not only in the Information and Communication Technology (ICT) sector, but in other fields, as well.

In Estonia about half of the IT workers are working in the ICT sector and half in other fields [8]. Also, IT companies in Estonia sometimes hire people who do not have an IT degree. It has been found that only half of Estonian IT workers have a higher education degree [8]. Thus, both those students who are studying IT and those who drop out of their IT studies can apply for a variety of jobs that require digital competence.

During past decades research on dropout has moved from the psychological viewpoint (students' individual attributes, skills, and motivation) towards a more complicated viewpoint that takes into account the role of the environment in the institution [9]. Larsen et al. [10] divided theories about dropout into four groups: economically, psychologically, organizationally and sociologically grounded theories. According to the economically grounded theory dropout is a rational decision based on the relationship between students' estimated investment in education and estimated return on education. The psychologically grounded theory tries to describe a typical dropout and focuses on factors like study behavior, perception of and attitude towards studying. The organizationally grounded theory explain dropout by focusing on participation, communication and membership in academic communities within the university. Last but not least, the sociologically grounded theory considers social and institutional structures as most important in understanding dropout.

Although the reasons for students dropping out cumulate individually [11], many studies have investigated dropout reasons in higher education. Based on a systematic review above all the previously mentioned theories, Larsen et al. [10] differentiated between eleven factors influencing dropout: (1) sociodemographic background of students, (2) academic competencies/pre-requisites for studying, (3) preparation for studying, (4) motivation for studying, (5) learning strategies, (6) study conditions, (7) social and/or academic integration within university/adaptation to university life, (8) overall evaluation of university life, (9) outside opportunities for dropouts (e.g., favorable business cycles), (10) economic situation of students, and (11) living conditions including housing, family and personal situation or support and student jobs. Firstly, the current study investigates how the factors concluded by Larsen et al. [10] relate to each other and affect first-year IT students' retention.

Secondly, the current study investigates IT students' retention following one of the most often used dropout models which is developed by Vincent Tinto and which follows sociologically grounded theory. Tinto's [12] complex model of students' departure includes some of the factors that Larsen et al. [10] found with the systematic literature review: sociodemographic background, academic competencies/pre-requisites for studying, preparation for studying and academic and social integration. The model shows that the following aspects are an important influence on students' dropout decision: pre-entry attributes (family background, skills and abilities, prior schooling), goals/commitments, institutional experiences that can be divided into academic and social, and academic and social interaction. Academic experiences are divided into formal academic performance and informal interactions with faculty and staff. So, grades and collected credit points can be seen as part of a formal academic experience that could influence students' dropout decision. Other studies have also shown that students with lower academic achievement exhibit a higher probability of dropping out [13–15]. This can be explained by the rules set by universities – if a student does not pass enough courses during a year he or she will be expelled.

Dropout is a process – a period when students are thinking about dropping out, which may lead to either actually dropping out or continuing their studies. During that period it is still possible to change students' minds and support them in order for them to opt for continuing the studies. Students' uncertainty about their graduation refers to their low graduation-related self-efficacy. Self-efficacy is defined as people's belief about their ability to perform successfully in a certain activity or task [16] and the results of previous studies [17, 18] indicate that if students have higher graduation-related self-efficacy, they are more likely to actually graduate. Because the IT students who participated in the current study were still studying in the university, actual graduation rates were not available and first-year IT students' graduation-related self-efficacy is under investigation.

1.3 Integration of IT Students

In Tinto's model social experiences are divided into formal extracurricular activities and informal peer group interactions. Social integration includes feeling part of a group, being satisfied with introductory courses, feeling able to question lecturers, and socializing outside university hours [19]; this may influence a student's decision to continue studying or drop out. Such ways of communication have also been found important already in the process of students choosing the university [20]. However, social experiences are also interactions outside university with other IT students or people in the IT field, e.g., in the IT work environment.

Students work during their studies mainly for two reasons: earning money or getting work experience, which is valued in the labor market [21]. Students can work in different areas if the goal is earning money, but if IT students want work experience then they need to work in the IT field. So, in addition to interacting with computers and developing digital competence in their studies, IT students may also experience this at work. Working in the IT field engages the students in the community of IT workers, which could influence their decision to graduate. This means that working in IT field can be seen as part of social integration of the students. Therefore, the current study focuses only IT-related work (not any work that IT students might do). However, it has been found that working during studies can have a negative effect on studies owing to less time for studying, increasing the likelihood of dropout [22, 23]. In Estonia it has been found that already at the beginning of the first semester 8% of IT students report working in IT field, and other students are also considering work [24]. It can be concluded that working during studies is an important part of the social experience that could influence the graduation in IT curricula.

1.4 The Aim

A number of bivariate relations between variables that influence dropout or retention can be found in the literature (e.g. [10]); however, it is not known if combining them into one multivariate model gives a better overview of what influences the graduation-related self-efficacy. Therefore, the first aim of this study was to establish

which factors that influence dropout based on [10] are related to one another and based on that create the first model of graduation-related self-efficacy for first-year IT studies.

The second aim was to take a well-known dropout theory (Tinto's dropout model [12]) and implement it in first-year IT studies. Thus, the second model can be created that shows the role of academic experiences and social work-related experiences in graduation-related self-efficacy.

2 Methods

2.1 Participants

The participants of this study were 509 higher education IT students who started their studies in 2013 and 2014 in three higher education institutions in Estonia and eight different IT related curricula. 71.5% of them were male and 28.5% female. This is similar to the gender distribution in IT studies in Estonia, where about 75% of the students are male [24]. The students responded to questionnaires twice: at the beginning of the first semester and at the beginning of the second semester. In addition, data about students' academic achievement – average grade and collected credit points (in ECTS, i.e. European Credit Transfer and Accumulation System, 1 ECTS means 26 h of work) – was collected from the universities' study information systems.

2.2 The Instruments

The questionnaires were designed based on the factors that could influence dropout, differentiated by Larsen et al. [10] (see variables and constructs in Table 1). While designing the questionnaires expert discussions were held with people teaching IT students to increase the validity of the instruments. The questionnaire included the following blocks of questions in the following order: background information, multiple choice questions (questions about knowledge of job opportunities, prior experience with studying IT, curricula, and studying in the university), open-ended questions that required a short answer (questions about the probability of graduation, working in IT field during and after studies, communicating with other people in the IT field), and additional questions (e.g., about prior work in IT field). To learn about students' motivation the Academic Motivation Scale (AMS-C 28) College (CEGEP) version [25] was added to the end of the questionnaire. The scale contained 28 items that students had to evaluate on a 7-point scale. The Academic Motivation Scale helps to determine 7 constructs of motivation: intrinsic and extrinsic motivations are both divided into three subcategories, a motivation being the seventh category [25]. While analysing the data, the average score was calculated for all of the 7 constructs of motivation as well as for intrinsic motivation (includes three constructs) and extrinsic motivation (includes three constructs).

The IT students that participated in the current study still have some time until graduation. Therefore, the data about actual graduation rates was not available and students' graduation-related self-efficacy was the focus of this study. Graduation-related self-efficacy was measured by one question: "How strong is the probability of you

Table 1. Variables and constructs that were used in this study

Factors	Questions
Sociodemographic background	Age
	Gender
	Native language
Preparation for studies, academic competencies and pre-requisites for studying	When did you start to learn programming?
	How long did you learn IT in school?
	Have you worked in the IT field before?
	Average grade in the first and second semester
	Collected credit points in the first and second semester
Overall evaluation of university life, study conditions and learning strategies	How informed are you about your curriculum?
	How well does the curriculum meet your expectations?
	How complicated are your university studies compared to your high school studies?
	How pleasant are your university studies compared to your high school studies?
	How does a negative grade (failure) influence your motivation to continue your studies and graduate?
Motivation for studying	Academic Motivation Scale (AMS-C 28) College (CEGEP) version
Social integration within university	How many of your friends are also IT students?
	How many of your friends work in the IT field?
	With how many of your course mates do you communicate regularly after school?
Outside opportunities for dropout, living conditions, economic situation of students	Do you work in the IT field?
	How informed are you about job opportunities in the IT field?
	How strong is the probability that you will start working (or continue working) in the IT field during your studies?
	How strong is the probability that you will work in the IT field after graduation?

finishing your studies?", and the students answered by giving a percentage. The graduation-related self-efficacy was the focus of this study as students' perceptions of their graduation or dropout may lead to actual dropout if bad experiences or dropout reasons cumulate. Also, it has been found before that those IT students who will drop out estimate the probability of their graduation as being lower than those who will not drop out [4]. This suggests that graduation-related self-efficacy is related to students' actual behavior.

2.3 Data Analysis

Structural Equation Modelling (SEM) with the Mplus 7.31 program [26] was used for creating the models. The statistical indices used to evaluate the models were the following: comparative fit index (CFI) [27], standardized root mean square residual (SRMR) [28] and root mean square error of approximation (RMSEA) [29]. The following cut-off values of goodness-of-fit values were used: for CFI 0.95 or above, for SMRM 0.08 or below [30], and for RMSEA 0.1 or below [31].

3 Results

3.1 Initial Model of the Graduation-Related Self-efficacy

An initial multivariate model was created based on bivariate associations found in the literature. The model, shown in Fig. 2, is able to describe 78.4% of the graduation-related self-efficacy ($R^2 = 0.784$) and was the best model that came out with the SEM. However, the model is quite complicated, with rather poor fit indexes. For the first model, the CFI was 0.649 (below 0.95, which is the cut-off value [30]), SMRM 0.155 (greater than 0.08, which is the cut-off value [30]), and RMSEA 0.214 (greater than 0.1, which is the cut-off value [31]).

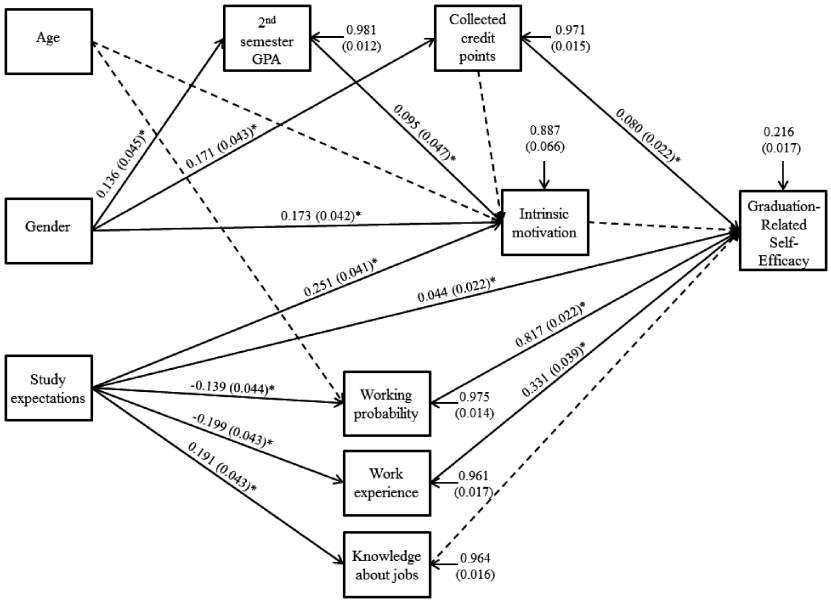

Fig. 2. The initial model of the graduation-related self-efficacy. Standardized coefficients are presented. Fit indexes: CFI = 0.649, SMRM = 0.155 and RMSEA = 0.214. * marks statistically significant ($p < 0.05$) associations; - - - - > marks associations that were not statistically significant.

The following variables were included in the model: age, gender, study expectations, second semester GPA, collected credit points, intrinsic motivation, probability of working, work experience and knowledge of job opportunities. Whereas some of the associations were statistically significant, some were not. The following is an overview of the statistically significant associations. Study expectations had an effect on the probability of working ($\beta = -0.139$, $p < 0.05$), work experience ($\beta = -0.199$, $p < 0.05$), knowledge of job opportunities ($\beta = 0.191$, $p < 0.05$), intrinsic motivation ($\beta = 0.251$, $p < 0.05$), and the graduation-related self-efficacy ($\beta = 0.044$, $p < 0.05$). The probability of working ($\beta = 0.817$, $p < 0.05$) and work experience ($\beta = 0.331$, $p < 0.05$) had an effect on the graduation-related self-efficacy. Gender had an effect on intrinsic motivation ($\beta = 0.173$, $p < 0.05$), collected credit points ($\beta = 0.171$, $p < 0.05$) and second semester GPA ($\beta = 0.136$, $p < 0.05$). Second semester GPA had an effect on intrinsic motivation ($\beta = 0.095$, $p < 0.05$). Finally, the collected credit points had an effect on the graduation-related self-efficacy ($\beta = 0.080$, $p < 0.05$). The other effects were not statistically significant. Still, the model is presented in the current paper to show that even if the associations between the variables were reasonable based on the literature, the multivariate model seems overly complicated, and not all the associations are important.

3.2 Integrated Model of the Graduation-Related Self-efficacy

An integrated model was created (see Fig. 3) based on Tinto's (1993) theory. The model includes two parts: academic experiences (GPA2, intrinsic motivation) that are affected by gender and study expectations; and social work-related experiences. In the case of work experience, the probability of working and work experience were combined into one latent variable, *Work*. The integrated model of IT students' graduation-related self-efficacy shows adequate fit based on CFI, SRMR and RMSEA. The CFI value was 0.970 (above 0.95, which is the cut-off value [30]), SRMR 0.069 (below 0.08, which is the cut-off value [30]), and RMSEA 0.086 (below 0.1, which is the cut-off value [31]).

The integrated model describes 94.1% of graduation-related self-efficacy ($R2 = 0.941$), which is more than the first model described. Two parts can be distinguished in the model: (1) social work-related variables and (2) academic success related variables. The work-related variables ($\beta = 0.969$, $p < 0.05$) are much more predictive of the graduation-related self-efficacy than academic success related variables ($\beta = 0.037$, $p = 0.05$). The effect of the work-related experience was very strong (even too strong), and the effect of academic experience was weak and on the edge of statistical error ($p = 0.05$). Also, only a very small part (3%) of the second semester grade point average is described by the variables in the model. The model shows that gender ($\beta = 0.184$, $p < 0.05$) and study expectations ($\beta = 0.261$, $p < 0.05$) had an effect on intrinsic motivation. Gender ($\beta = 0.112$, $p < 0.05$) and intrinsic motivation ($\beta = 0.111$, $p < 0.05$) had an effect on the second semester GPA.

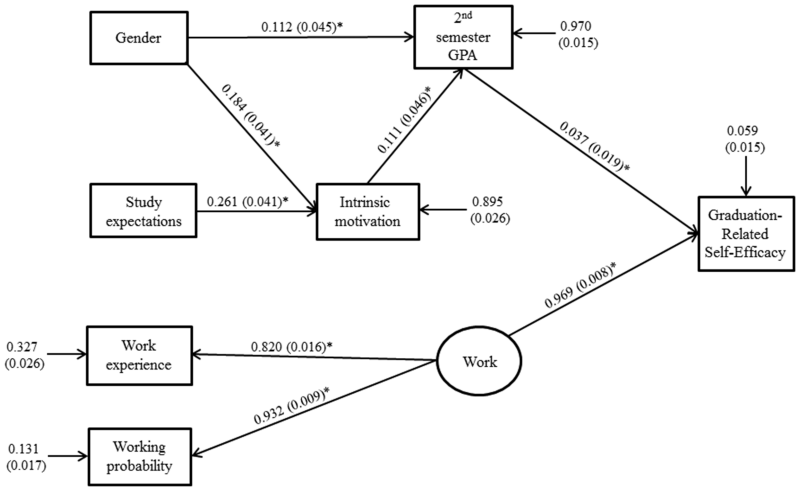

Fig. 3. The integrated model of graduation-related self-efficacy. Standardized coefficients are presented. Fit indexes: CFI = 0.970, SRMR = 0.069 and RMSEA = 0.086. * marks statistically significant ($p < 0.05$) associations.

4 Discussion

4.1 Bivariate Associations Give a Simplified Impression of the Graduation-Related Self-efficacy

The initial multivariate model was created based on bivariate relations found in the literature [10]. However, the model may be misleading as it includes, in addition to statistically significant associations, some statistically not significant associations between the variables and the fit indexes showed inadequate fit.

Other studies have detected bivariate associations between age and motivation (e.g., in the context of language learning [32]), as well as academic achievement and motivation [33]. In the context of the IT field it has been found that older students are more interested in working during their studies [24] and that knowledge of job opportunities may lead to work during studies, and from there, to dropout [22, 23]. However, these associations between the variables were not statistically significant in the model created. The associations between the variables are actually more complicated than the model shows, and it can be concluded that the initial multivariate model gives an incomplete impression of the graduation-related self-efficacy. Investigating graduation-related self-efficacy based on a more complex model (e.g., Tinto's dropout model [12]), not bivariate associations as presented by Larsen et al. [10], convey a better impression of what influences it.

4.2 Academic Experience Has a Weak Effect on the Graduation-Related Self-efficacy

Tinto's model [12] showed that both academic and social experiences had an important role in influencing the graduation-related self-efficacy. However, the effect of academic experience was found to be very weak ($\beta = 0.037$) for Estonian first-year IT students in this study. Also, the effect is on the edge of statistical error ($p = 0.05$). This means that the model can be applied to the IT field, but the effects of academic and social work-related experiences are slightly different from what the theory suggests.

Studies in other countries and other curricula have shown that academic integration has an important effect on student retention. It has been found that students with lower academic achievement (lower average grade and less credit points) exhibit a higher probability of dropping out [13–15]. Furthermore, Chen [3] discovered that the grade point average was the major dropout predictor. However, the results of the current study were not in line with these findings of previous research – in the context of the Estonian IT field, it was found that academic integration had a very weak effect on the graduation-related self-efficacy. This contrary result could be either specific to the IT field or the Estonian context. The IT field has its specificity, but the national culture and policy may also influence students' reasons for dropping out of higher education [19].

4.3 Social Work-Related Experience has a Major Effect on the Graduation-Related Self-efficacy

Based on the results of this study it can be concluded that social work-related integration is much more important in predicting the graduation-related self-efficacy than academic integration in the context of first-year IT studies in Estonia. A majority of the graduation-related self-efficacy can be described by work experience, which includes both the probability of working and prior work experience. So, social integration is important in the process of deciding to drop out or not.

Other studies have also revealed that social integration influences dropout in higher education. For example, Duque [34] found that student 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) influenced dropout. Working in IT field during studies could be similar social integration as students interact with people who work in the field of their studies. The negative side of working during studies is less time for studying, which may cause dropout [22, 23] or have a negative effect on students' academic progress [35]. Also, students may lose their motivation to study if the university teaches something that students do not need in their work. Therefore, IT students may choose to bring their digital competence labor market.

Other studies have also highlighted that there is a gap between employers' expectations and the skills of university graduates. It has been found in both engineering education and information systems curricula that in addition to technical skills (e.g., programming), employers expect students to have softer skills, such as communication and problem solving [36, 37]. Working IT students have also been found to

have less motivation to study than those students who do not work [38]. This suggests that the skills and knowledge taught in university are not what students who are working in IT field need in their workplace. Therefore, universities should collaborate more with IT companies and offer studies that meet the needs of their students' future jobs. Currently IT companies value prior work experience, but if university graduates have the knowledge and skills needed at work then prior work experience may become less important. This means that IT students will not have to work during their studies.

4.4 Limitations and Further Studies

This study had some limitations. The results could be problematic because the effect of the latent variable *work* on the graduation-related self-efficacy is very strong and the regression residual is low. This result seems too good. It might be that for students the work variable is almost the same as graduation-related self-efficacy. Also, the results may be influenced by the questionnaire that was used – the question about the graduation-related self-efficacy was located in the questionnaire next to questions about starting work in the IT field. However, the *work* variable included work experience, which was not located in the questionnaires next to questions about working and graduation-related self-efficacy. For further studies, several different questions should be asked about probabilities of work to prevent such problems.

The result could also be influenced by response rate. It could be that those who did not respond to the questionnaire were already dropping out and the ones who responded had higher confidence about their graduation.

The results suggest that the work aspect needs further investigation. In this study only working in the IT field was under investigation, but working in other fields during studies may also affect the graduation-related self-efficacy. Further investigation is required to understand why working in the IT field has such a strong effect on the graduation-related self-efficacy. However, it is difficult to investigate working students as there are no official statistics on this and self-reports is the only data collection method.

Further investigation is also necessary to see if the graduation-related self-efficacy is similar to the actual graduation. Longitudinal data collection from IT students in Estonia is currently planned. After the additional data collection all three study years can be included in developing a model for undergraduate IT studies.

5 Conclusions

The first aim of this study was to investigate the bivariate associations between the factors that influence dropout and to create a multivariate model of graduation-related self-efficacy for first-year IT studies. The results show that creating a multivariate model based on bivariate association does not give a good overview of the graduation-related self-efficacy because the associations between different factors are overly complicated in the model and statistical errors may occur.

The second aim was to implement Tinto's [12] dropout model for first-year IT students in Estonia and investigate the role of academic and social work-related experiences in graduation-related self-efficacy. An integrated model was created showing that both academic and social experiences have a statistically significant effect on the graduation-related self-efficacy. However, working in the IT field, which is part of social integration, has a major effect on students' graduation-related self-efficacy, and the effect of academic integration is quite weak. The reason why working is so important for the students might be that university studies do not meet the expectations of IT companies, who therefore demand work experience from IT graduates. The issue of dropout remains, but it can be recommended that universities offer students better preparation for entering the labor market in order to retain their students.

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