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The factors that influence women to choose and pursue a career in the IT sector: the case of Estonia

Master's thesis

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I have written this Master's thesis independently. All viewpoints of other authors, literary sources and data from elsewhere used for writing this paper have been referenced.

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Abstract

Estonia as well as the rest of the EU is struggling to find enough IT specialists. It is estimated that by 2020, the EU will have 500,000 of vacant IT positions which has a hindering effect on the economy that is moving towards more digitalization. Women are under-represented in IT roles and the inclusion of more female IT specialists could offer a solution that is both contributing to the development of the IT sector and the economy as a whole. A larger participation of women in IT roles could also decrease the pay gap that Estonia has and support gender equality.

This focus of this thesis was to find out which factors enable women to choose an IT-career. The research question was the following: what are the main influential factors that have encouraged women to choose a career in IT? In order to identify the enablers, eleven women were asked about their journey to IT including which aspects influenced their career choice and when the choice was made.

The analysis of the responses was done by identifying the emerging narratives and themes as well as considering other research on the same subject. Gender and IT does not have a strong theorization as an academic discipline, however, some authors have used social constructivism to provide the frame in which to work in. Social constructivism was also used in this thesis and it was complemented with decision theory as well as gender-focused theories.

The results of the analysis suggest that the choice that leads to an IT-career is often made young and that it is influenced by many social and internal factors. Practical tasks and positive feedback was mentioned several times by the interviewees as an enabling factor. Social relations were another influencing aspect in finding the way to IT. Curiosity and grit were also enablers that help women working in IT.

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Introduction

The under-representation of women in technical fields has been a point of interest for the past few decades. There have been interventions with some success, but the general picture has not changed dramatically. This does not mean that the current *status quo* is the desirable situation for the society. It is estimated that by the year 2030, there will be 20-50 million new jobs globally related to development and deployment of technology. These jobs are also among the highest paid. (McKinsey Global Institute 2017) The wider participation of women in technology would not only offer the sector the extra labour force it urgently needs, but would place women closer to wealth and the decision-making about the future technologies. Therefore, having more women in digital jobs would not only solve the labour shortage issue, but would also reduce the gender pay gap and inequality.

Information technology (IT) was chosen as a narrower field of the whole technology sector for purposes of this research as it is in the centre of the digital advancements. IT solutions are incorporated in almost any new technological creation and IT skills can also be used across the domains. When it comes to the theoretical overview and the empirical results from other studies, the terminology also includes Information Systems (IS), Information and Communications Technology (ICT), Science, Technology, Engineering and Mathematics (STEM), computer industry and computing. Although these areas have a different focus, the position of women is relatively similar and can therefore provide a necessary base for the current research.

Estonia as a location for carrying out the study provides an environment with distinct features. It is one of the most digitized countries in the world where the population is used to online solutions when communicating with the State. For example, over 40% of voters gave their vote online during last Parliament elections. In the ICT sector, apart from a seemingly welcoming image, girls and women are a minority representing 19.4% of the specialists - similar to the EU average. Additionally, Estonia also has the largest gender pay gap in Europe (Eurostat 2019), which speaks to the current situation of gender inequality.

Understanding the reasons of women's lower participation in the ICT sector is essential, not only for Estonia, but in the wider context of the European economy. As technology is taking more and more ground in every industry, it is vital that the EU has enough skilled labour to be competitive in a global scale. Currently, the EU is facing an estimated 500,000 of unfilled ICT positions by 2020 which has an impact on the whole market and the global competitiveness (European Commission 2018). The EU recently has brought considerable attention into specifically creating a more favourable environment for women to enter the ICT sector and to continue their career there. These include initiatives like the Digital4Her conference or starting a Digital scoreboard to keep track of gender includement. (European Commission 2019b)

The purpose of this research is to understand how women have chosen their career in the IT sector which leads to the research question: what are the main influential factors that have encouraged women to choose a career in IT? Even though there has been a lot of research about the barriers that stop women entering the technology sector, what promotes the choice of pursuing a digital career is a far less researched topic. Therefore, understanding when the career choice is made and what it is based on, could be very valuable when policy decisions are made.

The focus of this thesis is not trying to push women into IT at any cost, but rather the opposite: the IT sector needs the perspective offered by women as well as more people that are passionate about the field. It is about finding a match between capabilities, interest and the needs of the wider market. There are many women that would enjoy and excel as a specialist in IT, but for one reason or another, they have not had an opportunity that sparked their interest, the social stereotypes influence their decisions or there is a third or a fourth reason why they are not in IT.

This thesis follows the logic explained by Chip and Dan Heath, where in order to bring large scale change, the answer is not to look for obstacles, but to find what works and do more of that (2008). In this context, it means identifying the aspects that have already helped women to enter and remain in IT and encourage and duplicate these actions,

policies or circumstances. Therefore, this research is conducted in a solution-oriented manner and has an aim to be applicable in a larger economic setting.

The topic of gender and ICT is one with not a strong theoretical background, perhaps due to the relatively recent widespread emergence of and fast-paced changes to the digital technology. Nonetheless, there are many studies with empirical results done which focus on understanding the reasons for and finding solutions to the low proportion of women in ICT jobs.

This thesis utilizes theories that place gender in a larger societal context and which explain the influential factors in individual decision-making. In the framework of social constructivism, it is the social interaction where the reality is created (Kim 2001). The characteristics of a gender are also defined by the external conditions and give a reference on how to view the self (Crump, Logan & McIlroy 2007). These socially constructed views create the environment in which decisions are made and in this case, women's decisions about their career. The theory behind decision-making is briefly discussed as well to give a better overview of the different sides of the issue.

In order to find the influencing aspects that help girls and women step into and remain in the IT sector, ten interviews were done along with one written account. The respondents were all working as specialist in an IT role in Estonia, covering different positions, experiences and employment duration in the field. The interviews were transcribed and then analysed. The analysis was based on the responses by the study participants with the emphasis on identifying the influential aspects in the environment, narratives, perspectives and other elements that had an impact on the IT career decision.

The results of the analysis were then placed in the larger context of the society. Since the study was carried out in Estonia, the factors that emerged from the participants' answers were also weighed considering the local circumstances.

This thesis is divided into five chapters, with a conclusion, summary in Estonian and the references given at the end of the paper.

The first chapter has a focus on the current situation in the EU when it comes to the ICT sector and the female participation in the field. The issue of labour shortage is linked to the general economic development of the EU. The Estonian context of gender and digital jobs is described.

The second chapter goes over the theoretical background for this thesis. Social constructivism alongside with the gender-related notions in the ICT environment are presented. The influencing factors of decision-making and the empirical findings on women's participation in the digital fields are brought out.

The third chapter focuses on the methodology. The choice of the interviewing method is described as well as how the data was gathered. At the end of the chapter, the sample is described.

The fourth chapter concentrates on the analysis of the data including themes that emerged frequently from the narratives. It also gives an overview of the enabling personality traits and skills. In some cases, the comparison between the other empirical results and those from the current responses is pointed out. The chapter is divided into nine subsections of the emerged themes and topics to make it easier to have an overview.

The fifth chapter takes the results from the analysis and places them in the larger context of societal processes and policies. In some cases, the viewpoints of the study participants are added to reflect the current situation from their perspective.

The conclusion gives an overview of the entire study: its reasons, aims, the research process with the analysis and lists the results. Proposed actions are presented.

1. Women in the ICT sector in the EU and in Estonia

The global competitiveness of the EU cannot be taken for granted - if the EU wants to remain competitive in the long term, there needs to be a stronger increase in productivity and lower unemployment in the EU (OECD 2018). In 2017, youth unemployment in the EU was on average 16.6% which is in large part due to the mismatch between the skills needed and offered in the labour market (United Nations 2018).

In the European economy, the ICT sector accounts for 4.8%, and 50% of the growth in productivity is accounted to the investments made in ICT. (European Commission 2019) Moreover, ICT skills are gaining progressively more importance as digitalization is moving rapidly and taking a larger role in almost every field. The EU is facing a deficit of approximately 500,000 unfilled ICT positions in all sectors by 2020 (European Commission 2018).

In 2017, there were 8.4 million ICT specialists employed in EU-28 whereas the average proportion was about 17% as is shown in Figure 1. In Estonia, women held 19.4% of IT specialist jobs. (Eurostat 2019b). There was a study done in 2013 that highlighted the low number of women in the ICT sector. The authors found that if the digital jobs were more equally divided between men and women, it would translate into a nine billion EUR increase in annual GDP. (European Commission 2013) Another point of concern is the tendency of women stepping out of their ICT job, often in the most productive period. The productivity loss from women leaving their ICT job has been calculated to be 16.1 billion EUR annually. (Quirós et al. 2018)

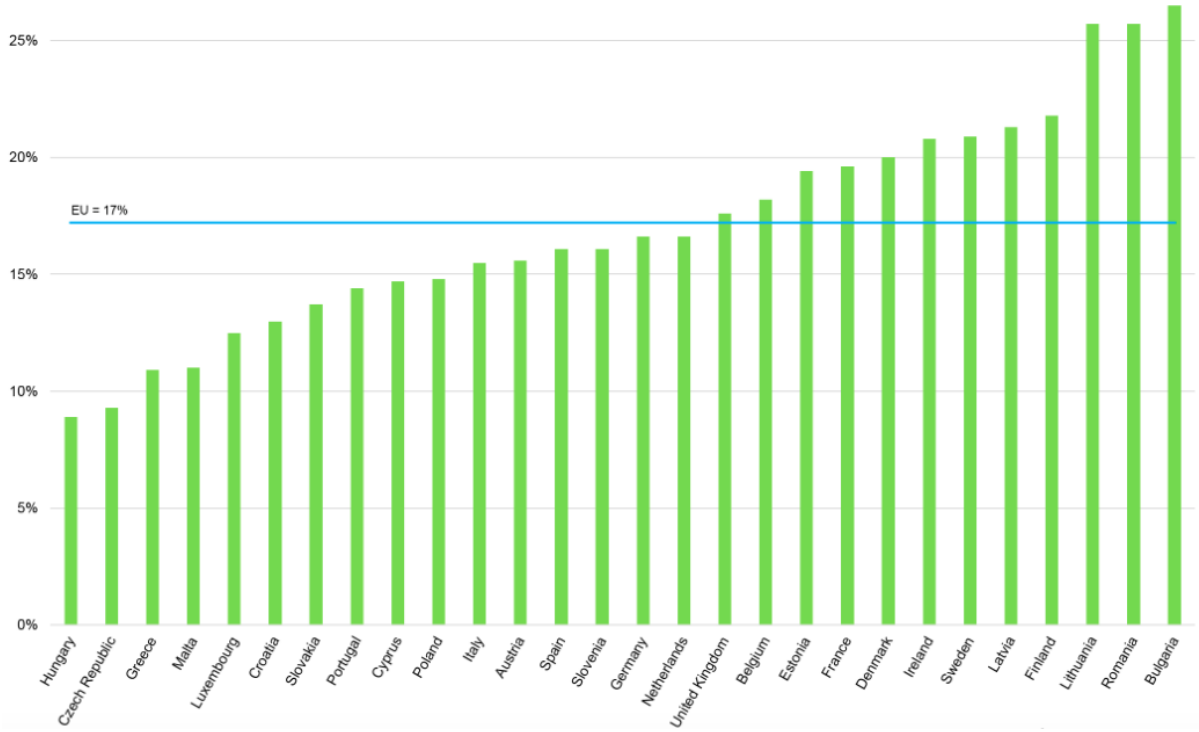

Figure 1. The percentage of women in an ICT specialist role by country in 2017. Source: (Eurostat 2018a)

In order to address the labour shortage and encourage women to step into the ICT sector, the EU has initiated programs and many of them were launched rather recently. Women in Digital is a policy under the Digital Single Market strategy. It entails several projects with the objectives to create an environment that would help increase the number of women in the ICT jobs. In June 2018, the conference Digital4Her served as a starting point for launching a network for women that work in the digital sector. During the event, the Digital Economy and Society Index scoreboard creation was announced which gives an overview of the data on the advancement of inclusion. The European Commission also started a campaign called No Women No Panel which means that the supporters that are invited to a panel would ensure that there would be at least one woman alongside them on the panel. (European Commission 2019b) As these measures have been taken recently, the influence cannot be adequately assessed at the time of writing this thesis.

Another way with which the EU supports developing a better qualified labour force is through the European Structural Funds. In the period of 2014 - 2020, Estonia received a

budget of 8.5 million EUR to advance digital literacy. These funds are directed to develop the ICT skills of the working-age population and include various projects with the same aim. (Majandus- ja Kommunikatsiooniministeerium 2019a)

Estonia has been called the Digital Republic referring to the many IT solutions the state offers (Heller 2017). The ICT sector is seen as essential and the shortage of specialists in the field has received a considerable amount of attention from both the private and the public sector. A few years ago, the Ministry of Economic Affairs set a target to increase the number of ICT employees by half by 2020. (Majandus- ja Kommunikatsiooniministeerium 2013). In 2013, there were about 19,000 people employed in ICT jobs and by 2018 that number had risen to approximately 25,000 employees (Statistikaamet 2019). A more recent report estimated, however, that the sector would need at least 37,000 ICT specialists by 2020. (Mets & Leoma 2016) The more specific area of cyber security would need an extra 270 - 870 new individuals. Cyber security is arguably in an even more difficult situation as the field is responsible of protecting critical infrastructure, public and private services, and is at the same time dependent on the general supply of the ICT labour force. Most people working in cyber security have an ICT background, a sixth of the specialists are from other disciplines. (Melesk, Mägi, Koppel & Michelson 2019)

In order to address the labour shortage, there have been several projects focusing on teaching ICT skills, raising awareness of the job opportunities, organizing events that promote the technology field and inviting specialist from abroad to Estonia. An example of an event that has an aim to make the ICT field more visible is the robotics festival Robotex which has been held annually for the past four years. (Majandus- ja Kommunikatsiooniministeerium 2019a) Another program is aiming to bring two thousand IT-specialists to Estonia and contains financial assistance for external employment activities for companies as well as marketing endeavours (including the promotion of Estonia’s e-residency) and the development of supportive services. The legislation for foreign workers has also been simplified in order to make this possible. The results are not final as the plan was designed for the period of 2018-2020, but currently show that a few hundred IT specialists already have come to work in Estonia.

(Majandus- ja Kommunikatsiooniministeerium 2018) All of these projects have had an impact to a certain extent, but there still remains a strong need for talent in the market.

Women make up about a fifth of the number of ICT specialists in Estonia (Eurostat 2019). The low number of women in the sector was also pointed out in a study done in 2015. There, a number of barriers were identified that restrict women entering or excelling in the field. The majority of them were connected to socio-cultural beliefs, such as stereotypes of the expected profile of an ICT specialist or the feeling of having to represent all women and therefore being afraid of making any mistakes. Additionally, there is a lack of visible women that are depicted as successful in ICT and therefore, the field does not provide role models that can be very impactful when young people make career decisions. (Kindsiko, Türk & Kantšukov 2015)

In Estonia, an NGO called TechSisters was initiated in 2013 which offers workshops and networking events that are meant to give opportunities for girls and women to try their hand in IT. There are also other voluntary initiatives which gather women already working in ICT to provide support and encouragement. The topic of gender equality comes up sometimes in the development plans of the ministries, for example the Ministry of Education and Research's Digital revolution (Haridus- ja Teadusministeerium 2019), but generally the efforts are directed towards advancing skills for everyone.

The most recent development is a program initiated by the Ministry of Economic Affairs and Communications which aims to introduce ICT field to the youth. The campaign dIKTeeri oma tulevik (dICTate your future) launched a webpage that offers introductory information, links to IT-courses and events like hackathons. The initiative is said to have a focus to raise awareness among girls and challenge gender stereotypes. (Majandus- ja Kommunikatsiooniministeerium 2019b)

2. Theoretical discussion

The theoretical discussion is presented at three levels. The first part focuses on the topic of gender in the labour force and gives an overview of the role of gender in the ICT jobs. Information Systems (IS) - the broader field where IT belongs to - lacks theorization when it comes to the notion of gender (Adam, Howcroft & Richardson 2004; Craig 2016). In general there is a larger focus on empirical results or the ICT and gender are addressed in reports which do not require a discussion on theory. When the theory is presented, it often includes the framework of social constructivism and/or theories dealing with gender.

The second part of this chapter is about the theoretical framework of how individuals make decisions. Since choosing a career is an especially complex process which is influenced by many factors, it is considerably beneficial to understand the possible effects of the social environment. The third part presents the empirical findings which compliment the general theoretical background.

2.1 Gender in the labour force

In social sciences, there are four theoretical traditions that explain gender. The first focuses on the origin of individual biological or social differences. The second looks at the social structure and how the gendered behaviour is created. The third addresses the social interaction and how that recreates inequality. The more recent approaches are integrative taking into account the cognitive models that children acquire from the culture and the accompanying gendered self. (Risman 2004) This research also focuses on an integrated view in order to present a more nuanced picture.

According to social constructivism, the reality is created or built by the members of the society. Gendered characteristics depend on the context and the gender identity can change when the external conditions become different. (Mehta 2015) One example of gendered attributes is the dualism of emotionality which is perceived as feminine and rationality which is more often linked with the masculine (Kelan 2008). The power structure influences the social construction and gives a point of reference for personal feedback by which to view the self. The self in this framework is also constructed in the

current societal circumstances and is subject to change as the environment changes. (Crump, Logan & McIlroy 2007)

As women especially tend to conform to societal expectations, cultural norms in both how women are brought up and how women's roles are seen, influence their career choices. The stereotypes in the computer industry influence women's career choices as certain subjects are seen as more masculine (Gumbus & Grodzinsky 2004).

In the IT workplace, the gendered patterns are constructed through everyday interactions and routine. (Panteli, Stack & Ramsey 2001) The western computing environments are dominated by caucasian men, especially on the leadership levels, and the male social construction considerably affects the workplace practices. Language is also an important aspect of what kind of reality is created, and in the case of ICT, it has masculine traits. (Crump et al. 2007) Women are generally perceived as having natural talent in people-oriented tasks while men have more aptitude on the technical side. (Moore, Griffiths, Richardson & Adam 2008) That said, Kelan points out that certain traits that are seen as feminine such as social competences have over time gained more value in the ICT workplace. (2008)

The gender inequality is often explained by arguments from liberal and/or radical feminism. The first poses that in order to reach equality in the computing field, there needs to be a larger number of women entering the discipline. It does not, however, offer significant insight into the reasons that have made IT less attractive to begin with. The second approach points out a certain masculine environment with its power distribution where women have less access to resources. In both frameworks gender is viewed as a static trait, which has been a target for criticism. (Perrons 2005)

There are differences between men and women in the jobs that they tend to choose. Some argue that these distinctions derive from varying values, such as family and work or competitiveness and finding the common ground. (Hakim 2006) Men and women often opt for a path that seems appropriate for the respective gender. The personal possibilities

are evaluated in the context of individuals comparing themselves to those they see as being in the similar position. (Risman 2004)

In the early 2000s, Ahuja published a comprehensive overview of barriers that were hindering women entering an IT profession. These obstacles have not changed considerably and are very similar if not identical to the present environment. She described social factors which include the self-image and stereotyping, and structural factors which point to the existing organisational norms that support the tendency of excluding women from managerial positions. (2002)

There is largely an egalitarian view on performance in the ICT sector - the success depends on the quality of the work. However, while there has been an increase in the number of women in some periods, the majority of the labour force still consists of men. (Kelan 2007) One of the solutions has been creating options for a more flexible schedule or other policies that can be described as family-friendly. Even though a popular choice, it has been observed that these changes have not had a major positive impact to advancing equality. The glass ceiling and the pay gap have remained largely the same. (Hakim 2006)

The reasons why women do not choose a career in the digital realm are influenced by many societal factors and is a topic that has been researched relatively well (as opposed to why women do choose a career in the ICT sector). When looking at education, women tend to choose a STEM program at universities relatively seldomly. Although the number of women entering STEM areas is growing year by year, there is still a noticeable gap. (Hill, Corbett & St Rose 2010)

2.2 How people make decisions and how career choices are made

The decision theory gives a larger framework in which people make decisions that are influenced by various beliefs and desires. According to the decision theory, individuals have options: preferences and prospects and the choices between those options are made to maximize utility as per expected utility theory. (Steele & Stefánsson 2016) However, as research by Kahneman and Tversky in the second half of the 20th century indicated,

the choices often do not follow rational thought (Lewis 2016). People are influenced by various factors including the way a choice is framed. (Tversky & Kahneman 1981).

In his groundbreaking work on thought processes Kahneman explains the brain's two ways of thinking: one quick, automatic and intuitive, the other slow and calculative. As the second "system" takes more cognitive resources, the brain switches to the first which often means using so-called mental shortcuts. (2011) One way to reduce the cognitive load, is using stereotypes. In the social cognition theory, stereotypes are a part of normal cognition processes and not a product of deficient culture (Schneider 2005). Therefore, although sometimes leading to the wrong judgment (Bordalo, Coffman, Gennaioli & Shleifer 2016), stereotypes are a part of the process of decision-making.

The choice of a career is full of complexity comprised of many unknown or not entirely comprehended factors (Gati, Krausz & Osipow 1996) which makes the decision susceptible to the quick, but sometimes not that accurate thinking pattern. If an individual had all the necessary information, such as personal abilities in the context of the future labour market, and knew how to maximise the returns (work satisfaction, income level), he or she could make a rational choice. However, as much of the knowledge is limited, people make decisions based on their past experiences, perceptions and often using mental shortcuts, such as stereotypes.

Identity and how it interacts with the larger social environment are among the most important basis of how choices are made. Jenkins made the point of identity being important not only in the perspective of how we see ourselves, but also how we are seen by others. In his book, Social identity, he described conformity and the motivations of it being wanting to be correct, but also wanting to hold on to the positive image in the eyes of other people. (2014)

When choosing a career, people have a tendency to choose a path that follows the cultural stereotype, for example, historically, women have chosen jobs that are seen as more female such as nursing and teaching. (Wigfield 2002) The effect of stereotyping was evident in an experiment where a computing course was moved from the faculty of

science to the humanities department. This change lead to more enrollment by female students who reported enjoying their studies and feelings of competence. (Doubé & Lang 2012)

Role models also have an important effect on the career choice. When a person wants to improve oneself, learn new skills or have a goal, he or she may select an individual as an example who is perceived to have particular expertise. Identification theory points to the emotional connection that individuals may have with the role models when they are seen as similar. Therefore choosing a role model can provide necessary inspiration and encouragement. (Gibson 2003) Role models, if they exist, have reported to be very useful and bring significant value to young women. Teachers are the most frequent role models because of their authority and the substantial amount of time they spend with the youth. (Clayton, Beekhuyzen & Nielsen 2012)

Another impactful aspect on the choice of which program to pursue at university was the level of which the students found the coursework enjoyable. This was especially significant for women as it was found that their choice was based on whether they saw themselves enjoying the future job they would be able to do after finishing studies. (Kahn & Ginther 2017)

2.3 Empirical research results on female participation in ICT

The factors that influence a girl making a choice of which area to pursue an education are often environmental and societal. For example, when girls are told that it is possible to develop intelligence by learning as opposed to having a fixed mindset, they achieve better results on math tests. (Hill et al. 2010) The environment created by the society, including school and parents, affects girls to put much more effort into technology and science fields in order to prove themselves. As female students are relatively more afraid of making mistakes, they are more likely to be deterred from subjects where failing is an important part of the learning process, such as IT. (Kindsiko et al. 2015)

In a study conducted with German secondary school students, it was found that the lack of girls continuing their education in ICT was due to not entirely understanding what

working in the ICT sector would be like and not having role models. This affects both male and female students, although it has more influence on girls' career choices. The limited knowledge means not recognising what a computer industry career could offer and which jobs are available (that it is not only programming). Teachers' insufficient training and resources are also issues. (Von Hellens et al. 2009) Misconceptions about ICT sector jobs is also one of the main reasons university students discontinue their studies as found when interviewing young people in Estonia who had dropped out of their program (Pedaste 2015).

Research shows that the family has important effect on career choices, especially when it comes to girls deciding to go into ICT. Parents' attitudes and their example, including the use of technology at home, influence children from a young age. A tech-savvy mother or sister can be a role model for girls thus providing inspiration, although any parental support has a good impact. (Clayton et al. 2012) A study that surveyed high school students on their possible career choices in the ICT sector reported that girls named parents as strong influencers in that decision twice as often than boys (34% vs 17%). (Babin et al. 2010).

Another research carried out in Italy, Poland, UK, the Netherlands and France included findings about girls' attitudes toward ICT. The data pointed towards many uninformed perceptions such as that ICT roles will not contribute to their wish to help others or be professionally involved in jobs that are to do with global or social improvement. This study also found a link between mother's positive attitude about ICT and the daughter's similar sentiment. (Gras-Velazquez 2009) According to research that looked at the Australian ICT sector, the respondents expressed four main reasons they chose their career: communal respect, work satisfaction, contributing to society and flexibility in employment. (Timms, Lankshear, Anderson & Courtney 2008)

Self-concept, the way someone sees oneself, is an important factor in choosing a career path because professions are chosen often by what someone is good at. Empirical research has shown that women generally see themselves as less competent when it comes to computers despite of evidence that places them at an equal or sometimes superior level

(Gumbus & Grodzinsky 2004). For example, in Australia, girls in secondary school reported having quite a low confidence level when it comes to technology. (McLachlan, Craig & Coldwell 2010)

These negative attitudes prevent female students from choosing ICT-related disciplines. In a study done in Spain it was found that the perceived computer ability is an important predictor of whether a young person intends to pursue their studies in ICT while self-concept of how good they are in maths does not. (Sáinz & Eccles 2012) Female students could have higher motivation in technical courses if the domains are perceived as creative and sociable and not dominantly associated with the anti-social masculine image (Doubé & Lang 2012).

For example, if a girl growing up rarely sees women working in the ICT field, this choice as a path for her is less likely to be among the options that she sees as a possible career for her. Here, the mass media is also an influencer which shapes the perceptions of the ICT jobs. Often the computer programmers are male and the users are female. (Clayton et al. 2012)

According to a study done in Estonia, the six most common myths of people working in ICT areas were the imagery of an antisocial man with an odd hairstyle (generally with a pigtail or braid), geeky person, that ICT only consists of programming, ICT education is essential or you must be strong in Maths, the overall masculinity of the field and that women need additional help to get to IT. The last point means that there should not be a push to get women to go into IT for the sake of it as it lowers the overall quality when in reality there is a mismatch between the job and the applicant or student. (Kindsiko et al. 2015)

A study done in the ICT industry in New Zealand showed that there were differences in styles of communication when it comes to different genders: the social expectation of men is that they should be more aggressive and even overconfident whereas women should not. This in turn supports stereotypes for certain professional positions where a masculine approach is perceived to be preferred thus creating an environment where women do not see themselves working in IT. Although there was a particular division of

labour between the genders, this did not translate into women's views on compensation and opportunities where they had a perspective of equality. (Crump, Logan & McIlroy 2007)

A research that was conducted in seven European countries (Austria, Belgium, France, Ireland, Italy, Portugal, and the UK) took a deeper look into the patterns in the life of women that had chosen ICT as their field of work. In the biographical interviews that included over a 100 women and over 30 men, a general finding was that women that already work in the ICT, see technology as attractive, their assignments challenging and diverse, and although there is a substantial amount of pressure from long hours, they are not inhibited by it. (Birbaumer et al. 2007)

There have been studies that have mapped the different entry paths of women that work in ICT. One categorizes the paths into three:

1. Direct paths: studying ICT at university or another higher education providing institution
2. Indirect paths: gaining a non-ICT degree which is followed by ICT-centered training for 6-12 months
3. Postponed entry: moving to ICT after pursuing another career. This is often done after a period of unemployment, career break or voluntarily. (Valenduc 2011)

In another study, the researchers found "an enormous diversity in how women entered the ICT field" (Birbaumer et al. 2007, p. 486). In that study, eight patterns were characterized:

1. "Straight careers in ICT" (Ibid, p. 487) - the career path starts with strong inclination towards mathematics and science, they see the ICT field as a good prospective and strive in the job.
2. "Combining art with technology" (Ibid.) - starting with an interest in art or journalism, the ICT field is first seen as a helping tool. Later technology becomes integral to the work they do.
3. "From the margins to a field of opportunities" (Ibid.) - women move out from their region into a promising job, ICT opens new opportunities for them.

4. “Building one’s own environment” (Ibid.) - women who define themselves by what they do and strongly shape their own environment in a way that suits them the best.
5. “Good work but limited ambitions” (Ibid.) - women who have a good level of competence in their work, but have only few professional ambitions, other life goals have an important role.
6. “Being open, having not yet arrived” (Ibid.) - mostly young women that have not decided on a clear path, yet, but are open to new offers.
7. “Struggling but not giving up” (Ibid.) - stories in which overcoming obstacles have a dominant place, the constraints can be anything from lack of necessary qualifications/degree to undesirable working conditions and limited opportunities in the respective region.
8. “Fragile or broken careers” (Ibid.) - stories in which the obstacles were not overcome, had a bad initial start into working life, wrong career step, disliking their ICT job, but also not seeing feasible alternatives.
   (Birbaumer et al. 2007)

Another concerning tendency comes from the choice to leave an ICT job which has significant economic impact. The European Commission recently published a report on women with digital jobs and found that there is a large drop-out rate for ages 30-44. This is usually the time where individuals are at the height of their career, but also an age that is often the time when the majority of Europeans start a family or are taking care of young children. (Quirós et al. 2018)

In a study conducted in Silicon valley, it was said quoted that “[women] leave our firm to advance their careers as they continually get passed over for promotion.” (Correll, Mackenzie 2016) This was largely due to female leaders not given the opportunities to take part in stretch assignments and lower likeability. For example, an aggressive leadership style which benefits men earning them higher visibility and respect thus translating into more opportunities and greater chance of promotion, has the opposite effect on senior women. They would be seen as abrasive which is a characteristic that does not help earning higher level positions. (Ibid.)

3. Research methodology

3.1 The choice of interviewing as a method

Interviewing was chosen as a data gathering method due to its possibilities in giving interviewees the freedom to tell their story in their words and thus discovering the narratives with rich detail and an option to further inquire about a certain topic on the spot. It can provide a holistic overview of the subject matter (Alshenqeeti 2014) and the method also enables the analysis to contain direct quotations from the interviewees which give a valuable insight into the topic.

Compared to other data gathering methods, interviewing also gives an opportunity to notice the tone of voice, posture, mannerisms etc. which can add to the meaning of what is being said. Interviewing also allows for flexibility in different styles of storytelling by the respondent as well as varying duration.

The limitation of interviewing is in the sample size which can translate into results being somewhat biased toward certain narratives depending on the individuals that take part in the study. The quality of the content also relies on the rapport the interviewer achieves with the respondent which can depend on many internal and external factors, such as personality match, general well-being and mood, meeting place etc. Finally, in analyzing the data, the qualitative method places a significant role on the person who works with the results.

In order to minimize these risks, the sample was designed to have women from varying roles in IT as well as different ages, backgrounds and companies. The interview time and place was offered to be chosen by the participant and in one case the conversation took place only in writing using social media and email. Preliminary interviews were done with two volunteers who helped test the questions and offered a general overview of the field. The test interviews are not a part of the sample analyzed in this paper. When it comes to the analysis, the author needs to be aware of his or her biases and remain as objective as possible.

A narrative approach was taken to map different events leading up to the choice to study, work and continue in the IT field. The narrative interview technique allows for study participants to tell their story in the language and form they choose which reflects the aspects and factors that have influenced them. (Bates 2004)

The analysis was carried out also with the goal of identifying the aspects of influence for the women. In order to organize the responses of the eleven study participants, a table was created to determine the commonalities between the stories. This helped to see which of the factors was brought up more frequently or which observations appeared often.

3.2 Gathering data and the description of the sample

The data for this research was gathered by conducting interviews with women that work in the IT sector in Estonia. Altogether eleven women shared their stories. Ten were communicated through an interview and one account was given via email due to the respondent's preference to convey her answers in writing. The written answers were deemed appropriate as they added value and another perspective. The interviews held were generally 25 - 35 minutes long with a few conversations lasting more than one hour.

The interviews were conducted either face to face or via Skype, both with video or audio only depending on the respondent's available options at that moment. The conversations were held in Estonian or in English. The questions were aimed to understand the influencing factors of the choice to go into IT and remain in the field. The central question - "How did you end up in the IT sector?" or "How did you come to the IT sector?" - was always asked at the beginning of the interview thus allowing the respondent to recount their experience in their own words. The subsequent questions specified the circumstances and rationale of the decision as well as discovering other opinions about the situations of women in IT. A few examples of the questions that were asked each time (although the wording may have varied depending on the flow of the conversation) were the following: "What is your age, how long have you worked in the IT sector and what is your job now? What were the alternative options? As you were growing up, was there anything in your environment that influenced you to choose IT? What are the reasons you have stayed in IT? Did you have any role models or were there other influencers in your

life? What are the characteristics that have helped you be in the IT sector? If a girl or a woman is thinking about IT, but is unsure, what would you tell them?" Afterwards, the interviews were transcribed.[1]

The sample represents a variety of positions, experience and background. The commonality of all the women is that they work in the IT sector in Estonia. Estonia was chosen as one member state of the EU with a similar ratio of women working in the IT sector as the EU average. It is a country where as well as in the other EU countries in general, there is labour shortage in the IT sector.

All of the women also carried a role in the more technical side of the IT sector excluding Human Resources and other non-technical supportive roles. The respondents were either involved in developing the software and in positions such as Product Manager, Developer, Designer, Software Engineer, Tester, or working in Cyber Security.

The women were aged 22 - 36 with experience from 1.5 years to 13 years in the IT sector. The relatively young age group was a result of a random choice as the age is not often visible on online sources with background information. As the average age tends to be generally lower than average in the IT companies, the group does match the overall characteristics. Three of the women had moved to Estonia from another country. Eight women had gone through the Estonian basic education system and nine had gone to university in Estonia.

[1] The transcripts are available upon request.

4. Analysis of the answers and narratives

The analysis was based on the content and narratives shared by the participating women. It includes their personal experiences and observations from their work and if they were involved in another project such as giving lectures, also from their teaching activities. The analysis takes into account the direct responses as well as attitudes perceived from the respondent.

While going through the interviews and the written answers, there were certain topics and themes that came up repeatedly. These were gathered under one category and discussed in more detail. The theoretical framework and empirical findings were considered in the analysis. The principles were compared to the findings of this research and discussed further where possible. Quotations by the respondents were added to give a more accurate and detailed overview of the women's experiences, thoughts and opinions. The respondents were numbered from 1-11 in order to enable the reader to follow the stories better.

This chapter is divided into nine subsections that contain the themes and narratives which emerged from the interviews. The first section compares the findings with the existing theoretical and empirical results from other studies when it comes to entry paths to IT. The other sections focus on the enabling factors and influencing aspects which have had an effect on each of the participants' career development.

4.1 Entry paths

In the theory section of this thesis, two groups of entry path categories were described. In the first, there were three types: direct, indirect and postponed entry paths. As shown in Figure 2, the most common type was the direct path. According to the narratives shared with the study participants, there were six women (2, 3, 5, 6, 10, 11) that followed the direct path which meant choosing an ICT field of study straight from secondary school, three that entered ICT from another area of study (1, 4, 8) and two that previously had a career in another sector, but decided to switch to ICT (7, 9). It should be noted that the indirect path prescribed a degree in a non-ICT field prior to a shorter 6-12 month training

in ICT. Only participant 4 had the exact match to this category. For the other two, the indirect path was expressed as studying in another program and changing to IT or finishing her studies in a non-ICT field and then going into ICT to work.

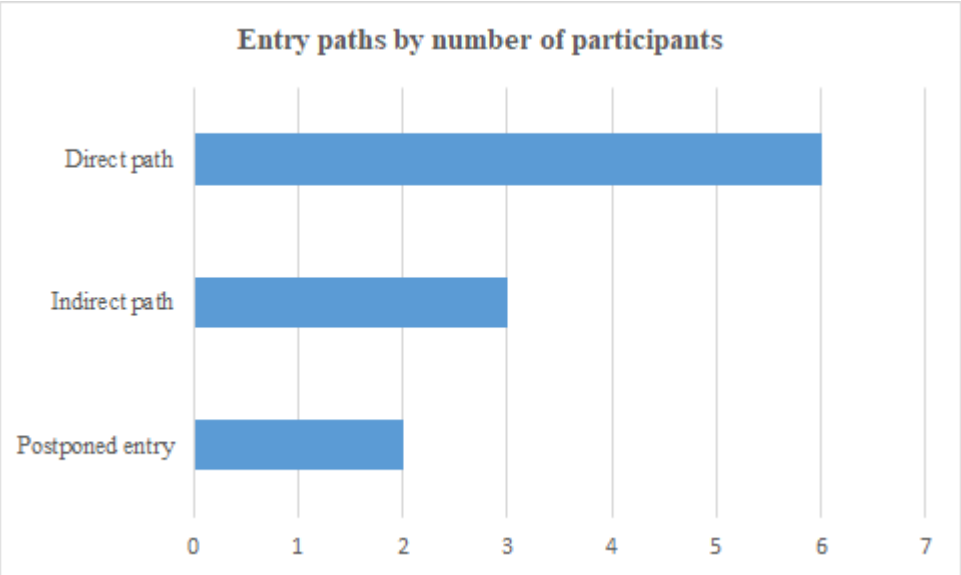

Figure 2. Entry paths by number of participants

The second set of categories had eight different paths. The first path, which indicated straight careers is very similar to the direct path of the previous categorization. Therefore, the six narratives from the current study can also be placed under that classification. It is more difficult to categorize the other five as the rest of the career sets are described relatively specifically. There are some characteristics in a few of the categories that fit an individual, but the narrative as a whole does not. For example they could have very deliberately chosen their field, thus creating their own environment, but as the paths describe a certain view of life, the story may not fit the category.

As more than half of the participants were on a direct path, it would indicate the tendency to choose a career rather earlier than later in life. Although this conclusion would need an accompanying quantitative study in order to have a more accurate picture of the proportions, it could mean that the most effective time to introduce the ICT field to young women, are the school years. On the one hand, this is the time when choices about the future career are made, but on the other, it is when the educational environment can offer a variety of options, including a possible digital career path.

4.2 Positive feedback in the form of results and verbal confirmation

When it comes to strong influencing factors of how women become not only interested, but remain in the IT sector, the aspect of practical involvement came up over and over again. The importance of seeing the result of what they had created tended to be either a turning point in their studies or something that strongly contributed to their decision to pursue a career in IT.

Participant 10 described how she liked coding at university because she saw the input and output of her work. This thought was also brought up by participant 4 who said having instant feedback is the attractive quality about technology for her.

Respondent 2 shared her experience she had in university where after two weeks of starting the studies, they had a practical task where they created a simple program. She described this moment as “so exciting” when she was able to see the result of her work. This alongside “great” people she had classes with contributed to her feelings from where at first she was not sure she will continue in IT to where she started liking the field very much.

At a time when participant 1 was learning another, non-IT subject at university, she realized that she wanted to do something where she is able to see the impact of her work. To her, an important moment was when she took part in a hackathon and went through the process of contributing to an actual product. She was able to learn she likes the process of looking for ideas.

Participant 5 recalled a summer where she took part in a course and said the fact she was able to build something on her own was probably what kept her in her IT Bachelor studies. When choosing between physics and IT, participant 6 who is now a developer made the decision to pursue IT since it seemed more practical and useful.

When asked what the women would suggest those that are contemplating, but not sure they should go into IT, many answered it would be good to try. This goes along with the paths that most participants experienced themselves, but also gives an insight to the need

of practical involvement as opposed to merely theoretical approach. Participant 5 said that “as long as you don’t [...] do, you don’t know.”

A hands-on tactic could also be used in making the ICT world more familiar to women and change their perception of it being to difficult and out-of-reach. After working for some while already in IT, participant 8 explained how she was not at first interested in programming as such and focused her attention towards testing. However, as time passed, she developed more interest in programming as her understanding grew and it did not feel as complicated as before. This change in perception is also in accordance with the empirical findings where females are less confident in their technical abilities, although in reality they are very capable.

Self-control and therefore delaying gratification has been depicted as a precursor of success for the last decades, especially after the famous Marshmallow test results were published (Shonda et al. 1990). In the light of the answers from the women on what they like about IT and how they chose the field, it seems that using the human propensity towards instant gratification could be extremely useful. If there were more opportunities for girls and women to try a practical task like writing a simple program or something similar, it would serve many purposes. Firstly, it would give the individual a sense of accomplishment. Secondly, trying it out gives an option to see if there is a match between the task and the interest. Thirdly, seeing the result of the work gives the brain the positive feedback and thus leaves the person with a positive emotion which would oppose the general view of “too complicated” that IT often has.

The practical tasks can also help increase self-confidence and therefore help women to keep going in the chosen specialty. Participant 3 recalled how at university she was not that good in certain subjects, like Math, but explained how seeing that she was good in programming gave her the necessary support to keep going.

Oral feedback is also a very effective form of support. Respondent 3 also described how she became involved in programming after receiving encouragement from a Math teacher at school. Participant 8 explained how it was useful to have a mentor during an internship

who was very demanding, gave difficult tasks and gave feedback in a rather strong manner whether it be positive or negative. This kind of teaching method where the task was strenuous and required hard work which was followed with praise, created a feeling of accomplishment and the conclusion from the interviewee that she was "doing the right thing."

4.3 Characteristics enabling working in IT

Every respondent was asked what characteristics have helped them to be in IT. People involved in hiring also explained what was looked for in a candidate. There were five character traits that emerged the most often either in direct answer of a participant or through their narrative. Figure 3 lists the five personal attributes that came up in the conversation or were deduced from the described behaviour. These include curiosity, grit, soft skills, consistency and a problem-solving mindset.

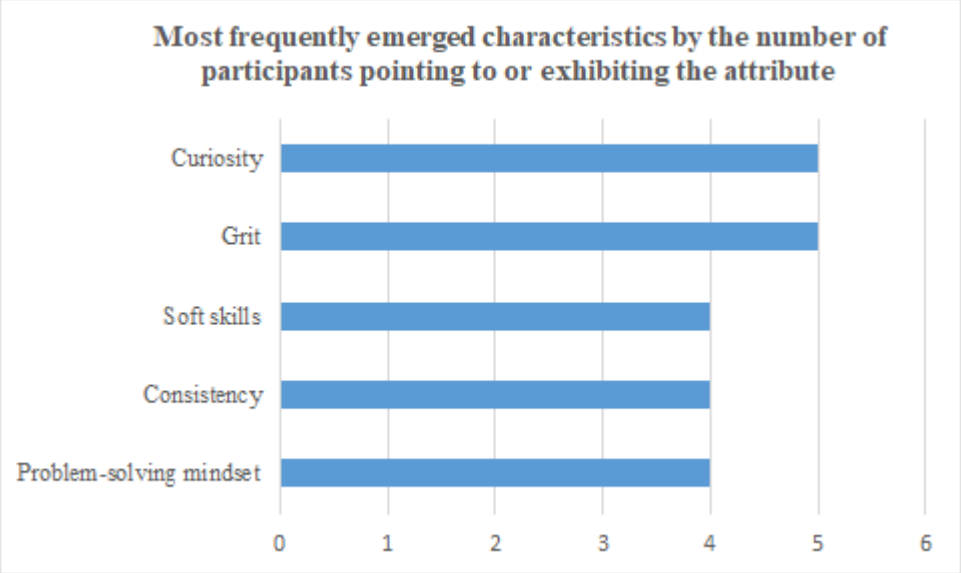

Figure 3. Most frequently emerged characteristics by the number of participants pointing to or exhibiting the attribute.

Curiosity was mentioned several times, both in the context of having curiosity and seeking that in a candidate for a job. Participants 7, 9 and 10 mentioned curiosity directly as an enabling factor and participant 6 expressed it as wanting to understand how something works. Participants 4 and 8 even though not expressing it in words, exhibited

curiosity in practical terms. Curiosity, even though similar to having interest in something, is a separate attribute signifying a desire to understand something.

Respondent 6 shared how she was four years old and sometimes liked to take apart old radios when they were visiting her grandfather. Participant 4 described how she put together her first computer at age 16 as well as creating a webpage. Others remembered taking the covering away from the computer (participant 8) to see what it looks like or taking apart home appliances (participant 10).

“I was so curious how this machine works,” said participant 10 and later added that, “this curiosity actually helped me to solve problems in IT.” She continued saying that often when she was just starting out she came across a problem and her path for solving it was the reasoning: “There must be a reason and I must find this reason and then I’m sure I will be able to solve it.”

Another thing that the women often conveyed in words and that was apparent in their attitude, was the strength of character or **grit**. This was expressed as an attitude of “never give up” or how someone deliberately chose “the hardest” subject of the IT programs offered at university (participant 5). This sentiment was also expressed as an internal drive by participant 6, “My mind can’t be at peace if I don’t understand [...] where I have the problem. [...] I can’t give up.” Participant 4 shared, how, when she started in her first IT job, she had many feelings of worthlessness and feared to be fired, but “through that fear [she] forced herself to learn or to adapt.”

Grit and holding a strong position also help in situations where the women experienced prejudiced attitudes from university professors, colleagues or clients. Participant 5 who tests software shared a story of when she started her job: “I was this young and blonde girl, who doesn’t know anything until this one moment came where I had the chance to prove to one of my colleagues that I was right in this situation and not them and after that I was accepted as one of them. You have to remain firm in your positions.”

It is important to note that prejudice against women at workplace was not a prevalent experience and most participants said they have not noticed it much in their career.

When asked which characteristics have helped them to be in IT, **soft skills** such as empathy and communication skills were brought up by participants 1, 2, 7 and 8. The communication skills were mentioned in the context of building working relations on the job, getting information and creating a friendly environment. Participant 2 described that when the working relationship had been established, that helped to learn what other colleagues were doing and eventually move positions.

Participant 1 whose job is to create the user experience said that empathy was important because she needed to understand the users. All those that mentioned communication skills and empathy had a role that required them to interact with other people or design the product for users as a part of their tasks.

As "soft skills" are not stereotypically seen as a part of the IT profession, this result signifies the diversity of options where individuals can apply their skills. Participant 2 who pointed out the role of empathy in her career, studied IT at university, has had various other positions, but is now in a position where is able to utilize her communication skills to the fullest. This finding in accordance with Kelan's point on feminine traits becoming more valuable in digital jobs (2008).

Being **consistent** was the feature four women chose as they described what helps individuals to be in IT (participants 3, 4, 5 and 9). In one case this was identified by respondent 4 as being driven by the desire to be good at what she does. Respondent 5 explained that in IT, it is necessary to keep learning as the environment is constantly changing: "there hasn't been one day, yet, where I didn't have to learn something new." Participant 3 pointed out that there is constantly something that does not work and she needs to try different approaches until she finds the solution.

In the perspective where women tend to have more perfectionist traits and want to have a flawless result, having grit could be the quality that helps women from avoiding areas

that seem more complicated at first to where they feel enough confidence from reaching a goal and choose an IT profession (or any other field considered challenging from a distance).

The **problem-solving mindset** was mentioned or exemplified by participants 1, 3, 6, 7 and 10. As an answer to the question of which characteristics enable her to be in IT, respondent 6 explained she had always liked to solve puzzles. When she was younger, she had a favourite puzzle book with semi-mathematical problems. Participants 1 and 3 described situations where they solved issues thus exhibiting the approach.

As a part of the last questions, the participants were also asked what they would say to girls and women that are thinking of possibly entering the IT sector, but are unsure. “If they like solving problems, they should definitely go to IT,” advised respondent 10, also adding that there are constantly problems when working in IT.

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When talking about hiring, those that have been a part of the hiring process (participants 7 and 9), said that what counts more than education is the personality match. In large part what is being looked for is **motivation** and **enthusiasm.** This means that persons have shown by their actions that they are interested in the work that they have applied for. Participant 9 explained: "And I have found the same thing several times after the job interviews, [...] that people who have a job as they study, who are engaged in some hobbies, actually take on voluntary assignments, then even if they are not as strong in the respective field as those who have graduated from this area for example, then life has shown that these are the people that voluntarily learn more [...]. Respondent 2 pointed out that she had taken part in numerous job interviews and she was asked about her education in none.

Other personal attributes were mentioned less often. A personality trait that was not vocalized as much as it emerged from the narratives, was **conscientiousness**. Participants 2 and 5 described how they always had their homework done when they were at school. **Logical thinking** was brought up by respondents 1 and 5. The **ability to learn** was pointed out by participants 2 and 11.

4.4 The impact of social relations

The influence of family, friends or a larger social circle cannot be underestimated when decisions are being made about career or even when it comes to areas that are of interest. As research suggests, the environment where young women grow up can influence their future career decisions - for example, parents' actions can spark an interest in computers - so questions about if they remember anything that could have encouraged them, were asked from every participant.

Contrary to the previously cited studies, participants 1, 3, 6 said directly that the environment where they were brought up, if anything, was something that was working against them being able to choose IT. Participant 6 remembered her mother trying to

direct her towards typical “girlier” things as sitting in front of the computer the whole day seemed odd to her.

Fathers can play a significant role in girls choosing IT as a career. Participants 2, 10 and 11, mentioned their father as one of the influencers. Participant 11 said that her interest sparked from seeing her father build computers. Respondent 10 how she had a father who raised them as if there was no difference if they were boys or girls, for example taking the children to the car repair shop. According to the respondent, her father always was always encouraging her in her endeavours.

Grandparents were also named as individuals that had an influence on their choices (participants 6 and 8). Respondent 6 said that she had an inclination to please her grandfather who she admired and respected. Since he was a in a science field, that had some influence on her choosing a subject that is more technical.

For participants 2 and 4, their brothers had an impact on their interest in computers. Participant 2 shared how her brother showed her an image he had created in his programming class and participant 4 saw her brother putting electronics together.

One of the most often described factor in the women’s stories is the influence of certain people or a social circle around them as they were studying at university, already at work or in their private lives. Respondent 1 who was studying a non-IT discipline shared how she became a part of a circle of friends who were closely related to technology which had a “dramatic impact” on her. She started questioning why she was not into technology: “Didn’t I realize then that this is the future?” That was the point she began educating herself more on subjects that would help her in IT.

Participant 5 recounted, it was likely the student group who were all studying IT with her, that had an influence on her decision to remain in IT. Participant 3 also named the social environment as one of aspects that helped her at university saying that, “[she] was surrounded by extremely fun and intelligent people [...]” Respondent 4 described how she

very much liked the culture in the IT company that she was working for, although not in an IT-specialist role, and that was one of the reasons she then started learning more.

Participants 4 and 8 noted that their previous boyfriends had a role in introducing them to IT because they were studying IT. This can point to the demystifying effect that seeing someone active in IT has. Instead of the field being perceived as perhaps too difficult or "not for me," having a closer perspective can change the attitude towards it.

4.5 The attractive aspects of IT

The respondents were asked to name the aspects that attracted them to IT and what keeps them in the field. Among them, wide opportunities (participants 1, 2, 6, 7, 10 and 11) and good income (participants 1, 6, 7 and 8) were identified. Also, in the conversations, the social aspect and people in IT were pointed out many times (participants 1, 2, 3, 4, 5 and 8). The fact that the field itself is constantly evolving and progressing was also an attractive factor (participants 1, 5, 7 and 9).

An example of the opportunities that IT presents is illustrated by the example provided by participant 10 where she explains that an aspect that was important for her was the ability to contribute and "have an impact on someone's life." She remembers two stories that had made an impression on her where the people were creating IT solutions to help treat cancer patients or diagnose mental illness. Although, she herself did not end up in health care, these were important stories that helped her learn IT can be used in areas where it is possible to have a positive and substantial impact on people's lives. The inclination to choose a field where the individual sees an opportunity to contribute to society is also in accordance with the other empirical findings mentioned in the second chapter.

When individuals speak of wide opportunities, it requires a future image of themselves - they need to be able to picture themselves benefitting from those opportunities. This is an important finding as it signifies a certain movement from not thinking of IT as a career option, to entering in the field and then seeing oneself as a part of it, as someone that is utilizing the opportunities.

Something that is often portrayed as negative in the society and causes concern in parents was actually an entryway IT to a few of the women. In the conversations, what came up a few times, was that the respondents had an interest in computer or video games, in two cases the interest was very strong. Participant 10 described she was into gaming so much that her parents needed to intervene with the hobby so she could study for the final exams in secondary school. This interest in the end led her to want to be a computer engineer. The same opinion was seconded by respondent 6 that links her desire to study IT directly to playing games while she was growing up.

4.6 The specialty factor of IT

Many women conveyed the message that IT is not only programming and that there are many areas that do not entail writing a code the majority of the day. There was also a dissenting opinion by participant 6 said that emphasizing this makes it sound like programming is extremely difficult and needs an outstanding skillset. In reality, she explained, there is "absolutely nothing complicated." She added that the "specialty" factor should be brought down when female IT specialists are being presented in order to make the profession more common and thus more reachable for everyone.

The sentiment of "nothing special" was also expressed by respondent 3 who said, "What I always say, but somehow no one believes me, that there's nothing special in this field…" She continued by explaining that IT is just like any other field where it is necessary to work on becoming good at it.

In the example of cyber security, programming or development, it was pointed out by many of the women, that the area is hyped. For example, about cyber security, participant 5 said that it is not such a shiny field that people let it seem, especially when you want to go into it in depth.

4.7 The lack of role models and low self-confidence

Almost none of the respondents indicated that their choice to be in IT was due to a role model in their life, with one exception. The exception was participant 5 that had a female

role model who introduced her to certain people and with doing that influenced her choice of path when already in IT. However, this happened when she was already active in IT.

If taken directly, the lack of role models can be seen as going against the literature that claims certain examples have significant influence on career choices since in the shared stories there generally was not a particular individual that was chosen as an example to emulate. However, looking at the subject with a wider lense, this can also point to the causes of low number of women in the IT sector. If the role models are active in another field, then individuals are more inclined to choose another field.

Even though the participants did not point out certain individuals as role models that they chose, many did share the role of certain family members that had an influence on their view or interest in IT. Participant 6 attributed her choice leaning towards sciences to her grandfather and participant 4 felt certain familiarity with IT since her grandmother was a programmer for a long time starting from 1960s. The same respondent also described how her brother assembled spare parts and electronics which was exciting.

Although the central logic of this research paper was explained as finding "what works and doing more of it," then even if not pointed out as a singular factor by the women, role models could have an immense potential of being an enabler. This is because of the social character of the influence that humans in general are very responsive to.

In the theoretical part of the thesis, self-concept was identified as an important factor of a career decision. The empirical research results pointed to a generally low confidence that girls/women have in connection to technology which does not reflect their abilities. Participants 1, 2, 3, 4, 6 and 8 of this study described their feelings of inadequacy or having little faith in themselves at certain points on their journey, mostly in the beginning.

4.8 The role of learning and education

None of the participants mentioned basic or secondary school classes as something that sparked their interest in IT. In two cases, the women (participants 2 and 9) had had an experience where they were in a class where they were taught "IT skills," but that was

either very basic or even more of a negative encounter which they described as “horrible” (participant 2).

Participant 5 who also teaches at a university in Estonia pointed to the lack of preparation that the higher education provides for students. She personally has learned almost everything she knows from the job. The large gap from what is taught and what is needed on the job probably comes from the university’s classically theoretical approach whereas IT is a very hands-on field.

She recounted an incident which took place when she was giving a guest lecture. As she asked the students who are interested in the technical side of cyber security, almost everyone raised their hand as a sign of interest. However, when she next gave out tasks, half of the room started asking if the assignment is obligatory. This shows the attitude that if something needs to be done, the students “run the other direction.”

A few of the respondents were teaching classes in IT (participants 5, 9 and 10). When asked if they see any differences between male and female students, all had had a different experience. Participant 5 said that, women were quieter at the lecture. In another case, respondent 10 had seen women as more independent problem solvers. In the third case, participant 9 did not indicate any difference and added, there are the same number of male and female students in her class.

Participant 5 also shared how the men in her class “already have a background in IT, whether it be as a developer or from another kind of technical direction,” the women, however, have not had a direct experience with the topic.

When it comes to hiring, what was mentioned as more important than education, was motivation. “[...] I’ve heard these stories where someone is hired because of the sparkle in their eyes,” said respondent 7 which signifies motivation or enthusiasm. The same participant said this is also due to the labour shortage. Respondent 9 who has been involved in hiring expressed preference towards a candidate that has done an internship

or has a similar experience even if the applicant is less advanced in their studies, for example a first year student at university versus a third year student.

Something that was directly asked, but came up in the conversations with participants 1, 3, 5, 8, 9 and 10 was the constant need to learn. As IT is an field that is in constant change, continuous learning is an important feature that enables individuals to remain in it. Participant 10 who teaches IT classes explained how her students asked her when the constant learning was going to stop and she explained her answer, “And I told them, never! This is about how you welcome new things to your life.”

4.9 Choosing Estonia to pursue a career in IT

There were three women that participated in this study who were not from Estonia and who had moved to Estonia from another country. They all also moved from a non-EU country and each had a different path. Participant 1 came to study in university at a non-IT program and decided to start working in IT afterwards. Participant 10 was looking at different options in Europe and decided to move to Estonia because of the life quality that she saw here was higher than other places even though salary was lower than with the other offers. Participant 3 was looking for other options and came across Estonia where e-residence and e-governance attracted her attention. The last narrative would indicate that the promotional work of Estonia’s e-services and innovative approaches have borne fruit at least in this case.

5. Discussion and suggestions

The themes that emerged from the results of the analysis included the description of entry paths, enabling factors on the journey, the personal attributes as well as the image of IT and social relations. The results showed the following:

- The most common entry path was a direct one which means that the individual made the choice to study ICT after secondary school.
- Most participants described a practical task or the practicality of IT as something that sparked or increased their interest in the field.
- Curiosity, grit, soft skills, consistency and problem-solving mindset were identified as enabling personal characteristics.
- Family and other social circles have a strong impact on individuals' decision on pursuing an IT career.
- The social aspect, wide opportunities, good income and a constantly evolving field were pointed out as the attractive attributes of IT. Two participants link their interest directly to playing games.
- IT is not only programming, but programming is also not that complicated.

There were certain obstacles that also appeared in the narratives, such as low self-confidence, lack of role models and educational aspects:

- Over half of the women expressed feelings of low self-confidence that they had experienced.
- Only one woman named a role model, others did not have a role model that had an impact on their decision of entering IT.
- Although learning is imperative in IT, education is lacking in school and university

As three women had moved to Estonia from abroad, their narratives were described very shortly and in the example of one participant, the promotional efforts of Estonia as a digital country had reached her.

This chapter focuses on the possible actions that could be taken considering the results of the analysis. As the research was conducted in Estonia, the outcomes can most effectively

be discussed in the context of Estonia. However, many of the findings can also be used in a wider setting, such as improving the understanding of women in IT or checking if the same enablers have similar effect in other countries.

5.1 Opportunities in the public sector: education

Even though this thesis did not start out as research about the education system, it is impossible and undesirable to ignore the many arrows pointing that direction. The basic and secondary or vocational education alongside with university programs could serve as the most effective tool in introducing ICT skills to the future professionals in the job market as well as shape the environment for young women. Unfortunately, today, it is not reaching that potential. The following discussion will highlight the opportunities the public sector has in the sphere of education.

As the results showed, the most common entry path is a direct one which means the individual has made the choice to study IT at university or college and has then continued to work in the same field. Most of the women that had a direct career path knew they wanted to pursue a career in IT from a relatively young age. When looking at where their interest was sparked, then the narratives point to either a parent, teacher or the individual attractiveness of IT. This points towards the theory on role models and their effect on the career choices. It also tells of the significant influence that the home and school can have in encouraging girls and young women to explore IT as possible option for a career.

As the majority of schools in Estonia work under the direction of the Ministry of Education and local governments, this is an area that has a lot of potential and responsibility to offer young people the opportunities to be involved in IT. Teachers have a central place in giving the necessary training for the students to achieve IT skills as well as being potential role models to the young people. Their attitude towards female pupils matters a great deal.

The gap between main big cities and other regions was also mentioned in a story shared about an event focused on IT that was done in Ida-Virumaa. Compared to Tallinn and Tartu where the awareness has been relatively high and the students show their interest

“the principal [from a school in Ida-Virumaa] says that our girls do not study Maths or Physics.” This kind of attitude from a possible role model or someone that has influence over role models instills stereotypes which discourage female students to pursue their studies and career in so-called hard sciences and IT.

As the topic of teachers’ salaries has been rather sensitive, this could hinder the hiring of tutors that have strong IT skills. On the other hand, the education is the basis on which a country’s economic growth can be built and technology is at the centre of the current and future developments. This means IT skills - and not only knowing how to create a document - will be useful if not vital in every sector. Or in the words of a participant, “[...] IT is the future, in the end, we would all need to know programming at some base level.”

5.2 Possibilities of raising the quality of IT education

The practical approach in introducing IT could be one of the most important actions to take. Exposure to the practical side of IT gives girls and women the opportunity to get a sense of what the field is like and possibly recognize it as one they want to explore more. Therefore, it is essential that there are such places, events, subjects at school etc. that provide just that. There is a need to be mindful, however, of the content of such action. This is exemplified by an experience from a participant who said, “[...] I remember that we had an IT class, but I hated it. I even said to the teacher I will not do it.” She later studied IT at university. In this case, the focus of the class was the Excel program. The same opinion was shared by another respondent who admitted, “If only Word and Excel are learned in the computer class, then it is seen as boring and [the students] do not want to continue.”

For many women, the impact from seeing the result of their work was either a turning point or one of the important appealing features of IT. This is an important find as it provides a solution to several obstacles that stop women from choosing the career. Firstly, it gives a change for the individual to experience the positive feedback which can lead to increased confidence in the digital ability. Secondly, it gives an opportunity to create something through their own effort thus enabling the experience of achievement. That is

an important possible motivator to continue exploring IT. Thirdly, it has the potential to challenge the misconception that IT is "too difficult" as the practical tasks gives an insight to what the actual work could be like.

The question is how to find competent teachers in IT when there is an overall shortage of digital skills and there are many jobs to choose from. The issue is even more difficult outside of bigger cities as was described by one of the participants: "[...] if you have a school in the rural area, you cannot assume that you have an IT guy locally. Or [assume that] someone who could be very good as a computer teacher, [...] remains there, where he is with 0,25 part time work load, instead of going to Tallinn to do system admin and get 5-6 times the same salary." A possible solution could be **collaboration with the private sector**. Finding competent IT-specialists is key to the success of the businesses in the technology sector which means there could also be interest in providing support in teaching the subjects in schools. However, the role of an individual school in showing interest and coordinating the effort is important.

5.3 Utilizing the potential of social factors

Social factors are named as one of the most influential in making any decisions and especially when it comes to choices with substantial consequences like which career to pursue. As pointed out in the theoretical part, the social aspects are also one of the strongest obstacles for women in entering the IT profession. Although there are no quick fixes when it comes to societal processes, there are actions which could improve the general climate for a more gender equal IT workplace.

Crucial work is already being done by voluntary action in supporting girls to try technology-related tasks or women that are already in a certain IT field. This could be more financially assisted - the returns would likely outweigh the initial investment for both the private sector and the state as a whole. These organizations would not only be the necessary stepping stone for introducing the "trade" and offer networking, they would fill the very important social aspect of belonging to a group and have the support of the group.

Some respondents said that they were introduced to IT through their boyfriend or a social circle that had IT-specialists. Even though a personal connection is one of the most effective ways to become familiar with a field, it would be largely random if someone has the chance to have a closer look to an IT job. The introduction to digital jobs could be done much earlier and there should be more visible opportunities. This is as much the responsibility of the public sector that needs to make sure the economy is developing and the public services are progressing as well as the private sector which needs the specialists.

5.4 Gendered characteristics: changing the narrative

As was pointed out in the theoretical part of the thesis, there are certain characteristics that are seen as belonging to women and others that are more masculine. One of them is the fear of making mistakes or in other words, perfectionism, that women are more prone to. There are at least two ways to overcome this obstacle. The participants of this study showed a certain level of grit and persistence that helped them to pursue IT. The mindset of not giving in is one way of coping with failure which is a part of working in IT. The other option could be reframing mistakes and failure as a part of the process of learning and developing. This requires a wider-scale effort of changing the perspective and expectations of girls.

In two narratives there was a direct link between gaming and the choice to continue in IT studies when the time came. This finding gives a contrasting perspective to the widespread belief that screen time after a certain limit has harmful effects (Dunckley 2014). Gaming is also one of those activities that is more likely to be attributed boys and is more accepted as a masculine activity which can deter girls from taking interest in it. The most helpful action in this case would be giving the parents, schools and the general public the tools and skills to understand the opportunities of young people's interest in gaming as it may lead to career options otherwise not reached.

5.5 The implications beyond Estonia

Doing research in a smaller setting has its benefits and disadvantages. On the side of advantages, the results would likely be applicable to the smaller group and would thus

probably be more effective. On the other side, what works in one society, may not work in another. The EU is facing a notable labour shortage of ICT workers and in order to solve the issue, each Member State needs to step up. That is to say, Estonia has an opportunity to concentrate its efforts to meet the demand and that will have an effect on the larger economy.

Another contribution that this thesis could make is to the empirical findings on the topic of women in IT. As the purpose was to find the enabling factors that help women to choose an IT career, the results can be taken into account or they could be checked further among a larger sample or a different location/environment.

Conclusions

There is a lack of IT specialists in the EU that can reach an estimated 500,000 of unfilled ICT jobs by 2020. As only every fifth specialist in the field is female, this represents an opportunity to have larger involvement of women in ICT. Alongside with providing a solution for at least filling a part of the necessary ICT-positions, including more women addresses the issue of the gender pay gap (ICT jobs have generally higher salaries than average) and provides a wider range of perspectives as the society is becoming more digital.

The small proportion of women in the ICT sector can be framed by the social constructivist theory alongside with the decision theory. The first gives a general explanation of socially constructed perspectives that women have of themselves and their role which then influences their behaviour in the labour market. In this case, girls might not choose to explore IT because they do not see themselves as working in an IT job. Decision theory adds to the understanding of how people's decisions are often not based on pragmatic reasoning, but influenced by many other factors, such as stereotypical thinking.

In this thesis, the question of what enables women to choose the IT sector was critically examined. Estonia was chosen as the location of doing the research since it is an EU Member State with a similar share of female ICT specialists as the EU average. The aim was to identify the factors that help women to pursue a career in IT and the main research question was the following: what are the main influential factors that have encouraged women to choose a career in IT?

Understanding this subject would help to develop an environment that encourages more women to consider IT as a career path. In order to find the influencing factors, eleven women were asked about their journeys to IT. Ten were done in an interview form, one preferred to answer in writing.

The themes that emerged from the results of the analysis included the description of entry paths, enabling factors on the journey, the personal attributes as well as the image of IT and social relations. The results showed the following:

- The most common entry path was a direct one which means that the individual made the choice to study ICT after secondary school;
- Most participants described a practical task or the practicality of IT as something that sparked or increased their interest in the field;
- Curiosity, grit, soft skills, consistency and problem-solving mindset were identified as enabling personal characteristics;
- Family and other social relations or circles have a strong impact on individuals' decision on pursuing an IT career;
- The social aspect, wide opportunities, good income and a constantly evolving field were pointed out as the attractive attributes of IT. Two participants link their interest directly to playing games;
- IT is not only programming, but programming is also not that complicated.

There were certain obstacles that also appeared in the narratives, such as low self-confidence, lack of role models and educational aspects:

- Over half of the women expressed feelings of low self-confidence that they had experienced;
- Only one woman named a role model, others did not have a role model that had an impact on their decision of entering IT;
- Although learning is imperative in IT, education is lacking in school and university.

As three women had moved to Estonia from abroad, their narratives were described very shortly and in the example of one participant, the promotional efforts of Estonia as a digital country had reached her.

The proposed actions based on the findings would be:

- Giving students in school and outside of school more opportunities for a hands-on practical involvement in an IT-related task so that young people could build a

program (or solve another problem) themselves and have a personal positive experience with IT as they see the result;

- Involving the private sector more in the efforts raising the quality of IT education both in schools and higher education institutions;
- Supporting NGOs that work to involve girls in technology;
- Increasing awareness of potential paths to IT, such as playing games;
- Providing opportunities for girls to develop curiosity, grit and offering the perspective for mistakes as being part of the learning process.

Summary in Estonian

Tegurid, mis mõjutavad naisi valima ja jätkama karjääri IT-sektoris: Eesti näide

Evelin Kaarma

Resümee

Naiste alaesindatus tehnilistes valdkondades on olnud nii akadeemiliste tööde kui ka avaliku ja erasektori huviorbiidis juba mõnda aega. On tehtud edusamme, kuid üldine pilt ei ole oluliselt muutunud. IT-spetsialistide seas on naisi vaid viiendik, seda nii Eestis kui ka Euroopas laiemalt (Eurostat 2019b) . Majandus liigub üha suurema digitaliseerimise poole, mis tähendab, et on vaja ka üha rohkem IT-oskustega tööturul osalejaid. Aastaks 2020 on Euroopas hinnanguliselt puudu ligikaudu 500 000 töötajat just IKT (info- ja kommunikatsioonitehnoloogia) alal (European Commission 2018). Eesti tööturg vajab 2020 aastaks 37 000 IKT-spetsialisti (Mets & Leoma 2016), 2018. aastal oli IKT sektoris töötajaid 25 000. Naiste suurem osalemine sektoris leevendaks seda tööjõupuudust ning tooks valdkonda teisi vaatenurki.

Naiste rolli on varasemalt uuritud nii IT, IKT, STEM (*science, technology, engineering* ja *mathematics*) aladel kui ka digitaalsete töökohtade raames. Kuigi nende uuringute tulemusi on ka käesolevas töös kajastatud, siis magistritöö uurimisvaldkonnaks on valitud IT. Kitsam valdkond annab võimaluse saada täpsemad ja seega ka potentsiaalselt efektiivsemalt rakendatavad tulemused. Põhjus on ka selles, et IT-lahendused on laialdaselt kasutusel uutes tehnoloogiates ning erinevates valdkondades, mis teeb ka IT-oskused ülekantavaks teistele aladele.

Käesoleva magistritöö eesmärk on paremini mõista, kuidas naised on valinud karjääri IT-sektoris. Uurimistöö läbiviimiseks on praktilistel kaalutlustel valitud Eesti EL liikmesriigina, kus naised moodustavad IKT-spetsialistidest EL keskmisele proportsionaalselt sarnase osa. Eesti on riik, mis on tuntud oma digitaalsete lahenduste poolest avalikus sektoris, kuid kus on samal ajal Euroopa suurim sooline palgalõhe (Eurostat 2019).

Uurimisküsimus on seatud järgmiselt: millised on peamised tegurid, mis on võimaldanud naistel valida karjäär IT-s? Varasemalt on palju uuritud takistusi naiste teel tehnoloogiasektorisse, kuid vähem on kajastatud IT-karjääri soodustavaid tegureid. Eesmärk ei ole sundida naisi valima IT-d, vaid vastupidi - IT-sektor vajab nii naiste pakutavat perspektiivi kui ka rohkem inimesi, kellel on soov valdkonnas tegutseda. Siinkohal on vaja leida sobivus inimese huvide ja suutlikkuse ning tööturu vajaduste vahel. On naisi, kes naudiksid tööd IT-spetsialistina ja oleksid erialal võimekad, kuid ühel või teisel põhjusel on IT jäänud nende valikuvõimalustest välja kas sotsiaalsete mõjude, stereotüüpide või muude põhjuste tõttu.

Teoreetiline diskussioon käesolevas magistritöös toetub sotsiaalsele kontstruktivismile, soorollidega seotud teooriatele ning valiku teooriale. Selleks, et leida tegureid, mis aitavad tüdrukutel ja naistel IT-sektorisse siseneda ja seal püsida, küsitleti 11 naist, kes töötavad IT-sektoris spetsialistidena. Kõik uurimuses osalejad töötasid Eestis. Valimis on esindatud erinevatel positsioonidel, erineva kogemuse ja tööstaažiga naised. Uurimuse käigus tehti kümme intervjuud ning üks osaleja vastas kirjalikult. Vestlused transkribeeriti ning seejärel viidi läbi analüüs.

Analüüsi käigus uuriti, millised on korduvad narratiivid ja teemad keskendudes võimaldavatele teguritele. Tulemused näitasid järgmist:

- kõige sagedasem IT-sse sisenemise tee oli otsene, mis tähendab, et otsustati õppida IT-d pärast gümnaasiumi lõpetamist;
- enamik osalejaid kirjeldas praktilist ülesande sooritamist või IT praktilisust kui midagi, mis tekitas või suurendas nende huvi valdkonna vastu;
- isiksuseomadused, mis võimaldasid naistel olla IT-s olid uudishimulikkus, “pehmed oskused” (näiteks suhtlemisoskus), järjepidevus ja probleemide lahendamisele keskendunud mõtteviis;
- perekonnal, sõprusringkonnal ja teistel sotsiaalsetel suhetel on tugev mõju naiste otsusele IT-karjääri jätkamiseks;
- IT muutsid atraktiivseks sotsiaalne aspekt, laiad võimalused, hea sissetulek ja pidevalt arenev valdkond. Kahe osalenu huvi tekkimine IT vastu oli otseselt seotud arvuti- või videomängude mängimisega;

- IT ei hõlma ainult programmeerimist. Kaks osalejat leidsid siiski, et ka programmeerimist kujutatakse ebavajalikult keerulisena ning see takistab naistel valdkonda astuda.

Uurimistöös osalejate lugudest tuli välja ka teatud takistusi, nagu madal enesekindlus, eeskujude puudumine ja hariduslikud aspektid:

- enam kui pooled naised viitasid vähesele enesekindlusele, mida nad olid mingil ajahetkel kogenud;
- ainult üks osaleja tõi välja eeskuju - teistel ei olnud eeskujusid, kes oleksid nende otsust IT valimisel mõjutanud;
- enesetäiendamine on infotehnoloogias äärmiselt oluline, samal ajal jääb aga IT-haridusest koolis ja ülikoolis puudu.

Kolm naist olid Eestisse kolinud välismaalt: üks tuli algselt ülikooli õppima, üks osaleja valis Eesti elukvaliteedi tõttu, kuigi pakkumised tulid ka kahes teisest Euroopa riigist ja kolmandale jäi silma Eesti e-residentsus ning digitaalne kuvand, mis temas huvi tekitas.

Tulemustel põhinevad lahenduste ettepanekud on järgmised:

- luua rohkem võimalusi selleks, et noored või teised huvilised võiksid saada praktilise kogemuste, mis on seotud infotehnoloogiaga, näiteks mõne koodirea kirjutamine ja selle tulemuse nägemine;
- erasektori suurem kaasamine IT-hariduse kvaliteedi tõstmise jõupingutustesse nii koolides kui ka kõrgkoolides;
- toetada organisatsioone (MTÜ-sid), mis tegelevad tüdrukute kaasamisega tehnoloogiasse;
- teadlikkuse tõstmine võimalike IT valdkonda sisenemise võimaluste kohta, näiteks, et arvutimängude mängimine võib aidata tüdrukutes tekitada huvi IT-karjääri vastu;
- isikuomaduste nagu uudishimu ja meelekindluse arendamise toetamine tüdrukute puhul ning mõtteviisi muutmine selles mis puudutab vigade tegemist - IT-s on ebaõnnestumine osa õppimise ja millegi loomise protsessist.

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