Career Choice and Gendered Perceptions of IT – A Nexus Analytic Inquiry

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Abstract. Girls' disinterest in Information Technology (IT) careers is a persisting problem. We wanted to examine girls' perceptions of the IT field as well as factors shaping their career choices, to find ways girls might see IT/Information Systems careers as more interesting. For this purpose, we interviewed Finnish senior high school students, as senior high school is the last opportunity to influence girls' career choice in higher education. In addition, we asked senior high school IT teachers about IT education and their perceptions of students' relations to IT. Using nexus analysis as a sensitizing device, we focused on various discourses circulating around, different actors and their relations, as well as experience and background related matters that affect girls' career choice. Surprisingly gendered understandings of the IT field and career choices were still prevalent among the studied young people, and this supports educational and occupational segregation.

Keywords: IS education · IT use · IT education · Gender balance · Girls in tech · Gendering · Career choice · Segregation · Nexus analysis · Historical body · Interaction order · Teachers

1 Introduction

Due to fast-paced digitalization of our society, the Information Technology (IT) industry is prospering. However, there is a desperate need of skilled workers [49]. One solution has been to invite more women into the field [2, 33]. Herein lies an enduring challenge: girls are not interested in the IT field [8, 11]. The IT field is very segregated: the number of male specialists working in the field within the European Union has increased by 51.6% between 2008 and 2018, while the number of women has increased only by 5.1% [21], and across OECD countries only 20% of new students in the IT field were women in 2015 [48]. The gender divide is detrimental to the IT industry and the whole society as it affects the quality and coverage of IT, and delimits the responsibility of shaping of our digital lives mostly to one gender [64]. Thus, the topic should be of utmost interest in the IT field, including Information Systems (IS), among other areas of expertise.

Unfortunately, recent IS research shows that the problem persists in IS similarly to other IT fields [49] despite the relative 'softness' of IS, compared to more technical IT fields [34], and its association with business schools and business-oriented careers. A burning question is: why girls do not see IT as their career choice?

The situation is surprising, considering that we are talking about a generation that has had the internet, mobile technology, video games, and social media as an integral part of their everyday life from early childhood (e.g. [50]). Then again, young people's IT use varies: some use IT widely with increasing competency while others' use is narrower [37]. A digital divide among young people today exists, i.e. polarization between those who have the access and ability to develop their skills related to digital technology, and those who do not [47]. Research has shown that there are various kinds of exclusions in the young people's engagement with digital technology [32]. While there must be several reasons for this, we believe that education plays an important role. Based on our research, we believe that not only education nor IT use, but even more importantly other gendered phenomena explain the persistent lack of girls in IT education; cultural and historical aspects seem to be shaping girls' career choices as well. Even though gender aspects have aroused interest in IS research throughout the years [19, 34, 49, 53, 60], IS research has remained quite negligent of the young generations and their (IS) education [39]. Digital natives have been acknowledged as a generation distinctly different from the older ones [67] and calls for addressing the education of young people have recently emerged [32, 39] but IS studies examining the (IS/IT) education of youth or specifically young girls are lacking [64].

This study aims to understand girls' perceptions and understanding of the IT field as well as factors shaping them, to find ways to get more girls interested in IT/IS careers. Theoretically, we approach the topic using nexus analysis [52] that offers a lens to study complex topics in-depth and from multiple perspectives, including social, cultural, and historical aspects [31], guiding researchers to study circulating discourses as well as the backgrounds and experiences of those involved and their mutual relationships and interactions as shaping the action [45]. In nexus analysis, social action is in focus – in this study, it entails senior high school girls making sense of the IT field and their career choice. As our research question we ask, *how do senior high school girls perceive IT and the IT field, and what seems to be shaping their career choices*. We address this question in the context of senior high school in Finland through an exploratory questionnaire study with 142 senior high school students and complement that with six in-depth interviews with students and five interviews with senior high school IT teachers. We add the teachers' perspective to this study as they have been seen as very significant in shaping students' career choices [1, 5, 71, 73].

2   Related Research

Conceptual and Theoretical Background. As a theoretical lens in this study, we use 'nexus analysis' [52], specifically its three intertwined concepts: discourses in place, interaction order, and historical body [52]. Nexus analysis [52] is an ethnographically oriented research framework that draws on cultural-historical activity theory [69], theory on social interaction [24], practice theory [13], as well as the thinking of e.g. Nishida [46]

and Bateson [7]. *Discourses in place* tell us how participants position the topic as well as themselves in social space [10], e.g., the girls speaking about IT field as male-dominated and boring. *Interaction order* [25] guides us to examine the social arrangements between people. In our data, for example, this shows as mothers being important role models for girls. *Historical body* refers to life experiences of social actors. The concept comes close to the concept of 'habitus' [13] but is more closely related to participants' concrete embodied actions [52]. In our data, historical body shows, e.g., different expectations for girls' and boys' upbringing. The three concepts are used for examining the social action in focus. Use of the concepts helps examine the phenomenon of lack of girls in IT/IS. The concepts focus the analysis on interactions between individuals, always tied to the socio-cultural context. In real life these concepts are always intertwined in social action, but they can be used heuristically as analytical lenses to study the social action in focus (see e.g. [45]).

Other central concepts in this study are *gendering* and *segregation* that are seen influencing girls' views of the IT field and their career choices. With segregation we mean "the tendency for men and women to work in different occupations" [9]. This segregation impairs the overall economic efficiency [43] and affects companies' competitiveness around the world [2]. With gendering, we refer to "integrating the gender perspective in the understanding and construction of persons, phenomena, reflections, things, relationships, sectors of action, societal subsystems and institutions" [63]. We see occupational segregation and segregation emerging in higher education as problematic and gendering heavily contributing to segregation and vice versa. Next, we review existing IT literature addressing the topic. Nexus analytic lens guides us to focus on literature on girls' career choice and factors shaping it: their IT knowledge, assumptions, and experience (historical body) and other people's influence (interaction order).

Students' Career Choice. Women's decision to enter IT education is influenced by exposure at home, school, work, personal interest, salaries, and male influence to explore technology [53]. Values, perceived ability, and expectancies also explain why women do not get into computing [72]. In higher education, there is a scientific-humanistic divide (in curricula), but also a care-technical divide (in career applications), which are based on stereotypes of gender differences. Culturally ubiquitous gender stereotypes provide reasoning for gender inequality in society, where women are communal, and men are agentic. Exposure to the stereotypes can lead to supporting the system and the gender relations status. [35] There are cultural influences in attitudes about women's roles as mothers and the conflicts it creates in work life, but also the gendered cultural influences e.g. about careers, opportunities, and aptitude [61]. Cultural divide is also visible in how computing subjects are masculinized because of the technical orientation, whereas medicine leads to care-oriented jobs. Not all humanistic fields are care-oriented and not all scientific fields are technical, both divides influence career choice. [6] A newer explanation for gender gaps in engineering, math, computer science, and physics is that in post-industrial nations people choose occupations that they find highly interesting and they would love to do [16], and women in these societal contexts (e.g. Finland, Germany, and Hong Kong) tend to think computing subjects are boring [30]. With IS, students do not think IT could fulfil work values such as social interaction, work-family balance, and job security, and they think it is too technical [36]. Considering the impact

of economics, a more even distribution of material and social resources enables women and men to express gender specific preferences [22].

Perception of the IT Field. IT is often used interchangeably with terms such as ICT (Information and Communication Technology), IS, and CS (Computer Science), and there is confusion about IT occupations [4, 42]. Women are not often introduced to the IT field before college, and unfamiliarity may explain the disinterest in enrolling to the studies [38]. The IT field is diverse and offers various career paths but pre-college students are not seeing them if their parents are not employed by the industry [27]. Within IT, IS occupations can be seen as more feminine (more social) but the stereotypes and educational prejudices affect the IS field as well [34]. A study with secondary school students found that girls were less likely to know the difference between IT and IS and were less confident than boys in using IT [42]. Students' knowledge of IT careers is based on what they hear in school, and it is important to determine whether the representation of the industry is suitable for both sexes [58]. Students may not choose IT because of incorrect or vague perceptions of the field. Identifying and managing students' perceptions of IT careers at a young age could increase the number of women in the IT workforce. [1, 15] If we look at cultures and history of technology, men have been inventors and designers of technology, while women have been users and consumers. This divide has established a gender division in expectations, experiences and education. [14] Programming has been associated with mathematical problem solving and masculinity [12]. The bias in our society is also visible in children's toys and computer games [56]. Considering this past, girls today need to challenge stereotypes about traditional careers for women and be one of the few girls in the class if they choose IT education [54]. Girls think the field is unwelcoming to women, based on what they see on television and newspapers [11]. The IT stereotypes are that the field is male-oriented, socially isolated, related to machines, and requires natural abilities [17], resulting in girls' lack of interest in the field [26].

IT Experiences. Gender differences show in motivations for choosing an IT major. Men's primary influence is interest in games, whereas women intend to use IT in other fields. [15] Girls use computers at home less than boys do and they are not interested in programming and games. Computer use in schools is similar for both genders. While there are few gender differences in IT skills, there are differences in attitudes, interest, and self-confidence in computer use. [68] Girls tend to be more anxious for having less practice in computer related activities, and need more experiences, exposure, and practice to develop confidence and computer self-efficacy [29]. When choosing a career in IT, hands-on learning, exposure to IT, and an interest in IT careers are motivating factors in enrolling into IT education [54]. Men tend to have better self-efficacy, more passion for computing, and less positive attitudes towards women's abilities in IT. [44] Even with good access to IT, boys have reported higher self-efficacy in high level IT tasks [59]. As experience and education are essential for occupational self-efficacy in IT [44], increasing computer experiences could help women develop confidence in knowledge and use of IT [29]. However, a recent study found that girls in some countries reported significantly higher levels of IT self-efficacy and outperformed boys (e.g. Australia, Chile, Czech Republic, Korea, Russia), indicating that traditional gender perceptions are diminishing in some countries. [28].

Gender in IT Education. IT education is not a compulsory subject in most curricula, so encouraging girls to choose IT studies in high schools is important [18]. For example, in the Finnish national high school curriculum, IT is not on the list of subjects, but you can find it integrated into all other studies. There are no guidelines for teaching IT – the teachers are free to offer any kind of courses. [74] Gender differences in course taking behavior is a problem that seems to stem from women's experiences in classroom environments, stereotypical images, and individual interactions that reduce their sense of belonging [41]. Positive experiences and introduction to IT at home and in schools can influence major selections [53]. Perceptions of meaningful and creative activities can increase interest [8]. The choice to pursue a career in IT occurs before college, and encouragement and exposure are significant factors for girls [70]. Exposing girls to IT at an early age could counteract the cultural and societal influences that connect the idea of success with IT to boys and men [53]. If interventions take place early on, in middle- or high schools, they can tackle biases and inaccurate impressions before they affect major choice [3, 72].

Teachers' Influence. Career education and guidance in schools has been recognized as a foundation for lifelong career development [71], and increasing teachers' awareness about IT careers can help inform and encourage students [1]. Other ways teachers can influence students are through their teaching practices as well as the expectations they set to students. Regarding teaching practices, experiencing learning activities as creative and relevant are important for seeing value in learning IT skills. As to teachers' expectations, they can influence students' beliefs about their abilities, more so for girls. [65] The role of study counsellors and teachers can be of a conduit; they can reduce emphasis of mathematical abilities in IT careers and inform students that a background in business and social studies is also relevant in IT field [5]. Encouraging words and experience at home and at school are likely to increase girls' self-efficacy in male-dominated fields. Parents and teachers can show it is not gender or social structures, but aspiration, effort, and commitment that lead to success. [73].

Other People's Influence. Peers, particularly boys, have an impact on girls' self-concept, self-efficacy, classroom experiences, and external goal orientation, shaping gendered career choices [40]. At home, parental support is important [66]; fathers, male peers, and male siblings have a significant influence in motivating women to take part in tinkering activities [55]. In addition, role models are often mentioned as an important influence in selecting a career in a particular field [2, 20, 23].

3   Research Setting and Methodology

The study was conducted as a first step of a project aiming at increasing the interest of senior high school girls to study IT/IS. Despite women becoming more educated, occupations have remained segregated by gender in Finland. The majority of workforce in technical fields are men and the majority in social, care, and education fields are women. [57] In the project, we offer female senior-high schoolers more information and practical understanding of the IT/IS field and its work practices, hoping to raise

their interest in the studies. Due to our background in IS, we naturally emphasize IS aspects in the IT field, while other partners in the project place stronger emphasis e.g. on programming. Currently, we are in the exploratory phase, trying to gain deeper under-standing on the causes of segregation in the IT/IS field. The main data for this study originates from questionnaires filled in by senior high-school students (78 girls, 60 boys, 4 other/undisclosed; ages 15/10 students, 16/69, 17/45, 18/14, i.e. born between 2000 and 2003), as pairs (altogether 71 answers; 35 girl/girl pairs, 26 boy/boy, 10 mixed) in 75-minute-long 'IT info events' at two different high schools in Finland in 2018. The students could choose who they pair up with, and they were told we are interested in their views of the IT field. The events were organized by the schools' guidance coun-sellors; some of them were compulsory to the students. The aim was to highlight the diversity of the IT field in general and the 'soft' side in particular (i.e. the design, inno-vation, business, organizational, management aspects). Students were first given basic information about the current need for employees in the IT field. We then asked them to answer a set of questions as pairs to orient them for further information: What are their plans for studies after high school; How they perceive the IT field (the work, the people, the companies); How to inspire high school students to enroll into IT studies; How they perceive IT studies in higher education (why study/not study IT, what prereq-uisites there are). Then we informed them about the broad spectrum of IT companies (applications and devices) with local examples; career paths in IT field (IS specialist, UI designer, SW business manager, SW engineer, project manager, game developer, test engineer, etc.); salaries; and studies. Then we asked them, based on the information they had received, what topics they would be interested in IT studies or work and did the information influence their opinions about IT careers.

We complement this data with face-to-face interviews of 6 students in May 2018 (3 girls, 3 boys, 50 min on average), recruited in the IT info events. Interview topics included study plans after high school, what or who influences their career choice, parents' occupations and how they affect the career choice, IT use experiences at home and at school, and perceptions of studies and work in the IT field, and why we need more women in IT. Particularly with girls, attention was paid to how they perceive IT and what kind of experiences they have, and if they did not consider it as an option, why was that. With boys, we were interested in their views on IT, what experiences they have, and what they think are the reasons girls are not choosing IT careers.

To get complementary perspectives on the topic, we also conducted interviews with 5 high school IT teachers (ITTs). The interviewees were recruited through high school principals. 2 female and 3 male ITTs agreed to participate in ~1 h long face-to-face interviews, conducted in January and February 2018. The ITTs were asked about their knowledge and experience in IT, their teaching and ideas for development, teachers' role in influencing students' career choice, what they think students think about IT as a subject and a field, and why we should have more women in IT.

All interviews were audio recorded and transcribed. In the data analysis, the most relevant parts of the questionnaire data and the transcribed interviews were extracted into a spreadsheet. First, the data collected from students was analyzed by the first author who looked for how IT field was constituted in the interviews (discourses in place), experiences and skills of the students and how those influence their views of the field

and their career choice (historical body), and, who the students think influence their views of the field and career choices, and how (interaction order), highlighting both similarities and differences in the data. Then, the data collected from ITTs was analyzed using the same approach as the student data, looking at the teachers' perspective on the nexus of practice (choosing IT in high schools). All authors discussed the findings and interpretations together.

4   Empirical Insights

Table 1 summarizes our main findings from the survey data and interviews regarding our nexus-analytic inquiry into high schoolers' perceptions of IT field, their IT use experiences and career plans as well as their insights to issues influencing their career choices.

Table 1. A summary of students' perceptions about their career choice and IT

	Discourses	Interaction order	Historical body
Students' perceptions of the IT field	Programming, male-dominated, lonely, nerdy boring, difficult, on the computer, current, teamwork, social, versatile, requires dedication	High school does not introduce students to IT field. Media presents stereotypes of IT jobs and people; genius nerds, glued to their computers, working under pressure. Girls know fewer IT people than boys, neither know of any women	Students have no idea what IT workers do. Little knowledge about IS/IT. Students surprised about how versatile IT field is
Students' IT use and experiences	Boys more interested in IT	IT use introduced through a male in the family, mothers not in IT field. Students need to find out about IT themselves. Boys talk more about playing games	Schools increasingly digitalized. Girls and boys both play games. Students want balance in IT use. IT difficult to use
What students want	Everyone should be able to choose any profession - gender should not matter. Job should be interesting	Family influences what the students want through expectations and leading by example. Schools provide information and career guidance	Girls want social, creative, humanistic, care careers. Girls not interested in IT

Table 1. (*continued*)

	Discourses	Interaction order	Historical body
What students think influence their choices	Job security important. Salary should be big enough to live comfortably	Teachers' comments and families' upbringing practices seen as gendered. Media targets boys. High schools present traditional professions. Families' gendered encouragement and expectations. Friends not seen as significant influences. Girls' role models from family, artists, social media stars, boys' role models people close to them	'Old ways' – society's gendered expectations. Gender divide deep in society

Discourses Reveal Stereotypes and Lack of Knowledge About IT Work. Students in the survey described their views of the IT field as sitting on the computer all day (39 pairs/includes 47 girls), programming (17/27) male-dominated (12/21), boring (11/15), and nerdy (10/18): "*Maybe that it's quite boring… and you just work on the computer, and you're alone.*[1]*,*" (Girl1) Some girls said that IT jobs are unfamiliar to them: "*Not really, I just have the image that they fix phones and things, and it's not really interesting.*" (Girl2) The boys' answers were slightly less negative, and some described work in IT field as contemporary, social, and versatile. Some mentioned it can be difficult or complicated, and several used the words 'nerdy' and 'engineers': "*It's a stereotypical nerd job.*" (Boy1) Most of them knew that the employment prospects are good; salary ideas varied from bad (5 pairs) to mediocre (20 pairs) and good (21 pairs); working hours were thought to be 8–16 or flexible, with possibility for remote work. In the interviews, few students knew differences between IS and IT, and if they did, the difference was not clear: "*They haven't really been clarified for us, they're talked about in the same subject area.*" (Girl1) In the surveys, many students thought they should be able to code to apply to the IT field, and that it is too late to start in high school. Some associated IT with mathematical skills and thought it is a requirement in the field: "*Even if you're good at math, the reason you don't go there is the image of IT jobs.*" (Girl1) News and media (TV shows and movies) were mentioned as sources for these images: "*I think IT has that reputation, especially from movies, that there are those super geniuses that code a lot and it's very difficult and there's a lot of pressure.*" (Girl3) The interviewees knew IT leaders of big companies. Boys knew more people; the girls were not sure if they knew anyone. None of the students could think of a woman from the IT field. On the other hand, one girl noted that she "*wouldn't necessarily even realize that someone is from the IT field.*" (Girl1)

Historical Body and Interaction Order Shaping the Image of IT Field. IT use is a part of the everyday life for high school students. Computer use at school is differentiated from social media use: "*Well, I'm very active in social media, the computer is only for schoolwork… so Word, Excel. the basic things in high school. And then… Well, I don't really use the computer at home, e.g. coding I don't understand.*" (Girl3) During free

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[1] All quotes are from interviews.

time, social media and games are in focus. In the interviews, two girls said they play a lot, too; boys just talk about it more: *"I play quite a lot of play station games (…) Boys talk about gaming more, that they do it for many hours per day (…) but girls don't do that."* (Girl1) The high schoolers do not want to spend all day on the computer and that is one reason for not pursuing an IT career. They do not seem to realize that in large number of occupations working with computers is a requirement. The girls seemed to expect that boys or men in the family introduce them to IT, e.g. gaming: *"We have four girls in the family so there is no boy to bring the gaming into the family."* (Girl3) *"My dad plays a lot, so thanks to my dad I've become enthusiastic about gaming."* (Girl2) One girl mentioned her brother (Girl1), and one would watch her boyfriend play. The girls told that boys have more leniency in gaming and spending time on the computer, which gives them more experience: *"In my family the expectation is that we do our homework well, and they tell you to go outside if you spend more than an hour on the phone, and boys can play for hours without interference. (…) they can become interested in coding and make a career out of it."* (Girl3).

Regarding visibility of IT field during high school, the interviewees mentioned IT courses introducing the software students need for coursework and exams. Otherwise, their schedules were so full that there is no time for IT courses as there is no matriculation exam in IT: *"I could have taken the course [on IT] but considering the matriculation exams… fitting it in would be difficult."* (Girl1) The Finnish high school does not offer many opportunities to gain experiences in IT. The students said they find information about interesting fields or ask the guidance counsellors, so the interest in an IT career needs to come from the students themselves. The IT courses that some schools offer are mostly basic programming courses, some had media courses, but most had none. The questionnaires showed that some students (4 pairs) were surprised that you do not need to know programming when beginning IT studies in the university.

Interaction Order and Historical Body Shaping Career Choice. The interviewed girls mentioned family, mothers, artists, and vloggers influencing their career choice. The boys mentioned people close to them. The students did not think they have actual role models: *"I don't really [have role models], I make my own decisions. But opinions of other people and their stories of [different] fields influence my decision, of course."* (Boy3) All of the students thought that the way they are raised has an influence on their career choice; the girls mentioned their wish for parents' approval as a motivating factor: *"Parents do influence a lot, like for me the medical school, that… you want to please them."* (Girl1) The boys said that the parents mainly encourage them to do what they want to do: *"Family has an influence but not… directly. (…) They don't have any expectations, they say 'do what you want' so there's no pressure."* (Boy1) One girl said her mother is her role model: *"My mum is in the humanities, so that could be, actually the whole family is (…) so maybe that influences my choice. (…) Is it cliché to say my mom is my role model?"* (Girl3) In general, the girls felt that family has a strong influence on their choices. None of the interviewed girls' or boys' mothers were in IT field. None of the students said that friends influence their choice: *"Friends just encourage me to do what I really want to do."* (Girl1) When asked in the interviews what else affects career choice many historical body related issues were brought up, such as personal interests, values, past experiences, and employment prospects. Both girls and

boys said that personal interests and values direct career choice: *"I think personal values are important in what kind of professions you are drawn to, like, if you like animals you become a veterinarian."* (Girl1) *I've always wanted a job where I can dress nicely."* (Girl2) *"Yes, values matter. I want to study physics because I want to help make cleaner energy."* (Boy1) Salary was not seen as the most important aspect, but it would be nice to have enough to enjoy life: *"You do check how much the salaries are, it's nice to have good wages, but it's not the most important criterion."* (Girl1) Employment was also seen as important: *"You need to feel confident that if I start studies on this field I will get employed later."* (Girl2)

The interviewed students felt that 'old ways' and gendered expectations in our society influence the gender imbalance in career choices. Many students brought up the male-dominance in IT field: *"I think both genders can manage in IT just as well, but it's male-dominated because of old ways."* (Girl3) When asked whether the students saw it as an obstacle for choosing a field if they were in the minority, they would at first say no but then added that it could lead to feelings of isolation: *"Male-dominated environments would be a negative aspect, because it's different to exchange thoughts with women, I don't think I would feel like I belong."* (Girl1) *"If the guys stick together and a woman had an idea, the guys could just stick with their idea."* (Girl2) When asked why the IT field is male-dominated, the students said it was because of 'old ways' and girls are just not interested. One way to change the situation would be to introduce IT to girls earlier: *"Well like, you should catch the girls … at a younger age, similarly as boys are caught then, or, boys find the gaming world by themselves, but girls do not know how to search for it."* (Girl3) The students saw high school's role as mostly neutral in their career choice; however, in career counselling mostly traditional occupations are introduced, and the IT field is given less attention. The students said that the interest needs to come from themselves, while they can ask guidance counsellors for help and information. One student mentioned that a teacher had been a positive influence, otherwise teachers were seen as neutral: *I think that (…) all occupations are presented openly so they don't create any prejudice."* (Girl1) When asked whether their teachers have gendered assumptions, the students said, *"sometimes someone can say 'this field will probably interest boys more than girls'"* (Girl1), which the girls took to mean that it is not for them.

Teacher's Perceptions of the IT Field. The teachers were aware of the gender imbalance in IT, and all teachers thought women could provide different perspectives in developing IT. Perceptions of gender differences showed in the discourses, related to the ways of thinking and seeing the world: women were seen as better at seeing the 'big picture,' not just the technology. In addition, the teachers saw IT as gendered due to the lack of women, the women's roles in supporting tasks in the companies, and the cultural stereotypes of who IT professionals are and what they do. Generally, the teachers described IT work as diverse, with good employment prospects. They perceived IT engineering studies to be more about hardware and IS about software and how to use it.

Table 2 summarizes our main findings from the IT teacher interviews regarding teachers' perceptions of IT field, their IT experiences and their views on student's relationship to IT and the IT field.

Teachers Shaping Students' Views in Senior High Schools. All interviewees identified stereotypical roles related to IT in their schools: the IT teachers tend to be men

Table 2. A summary of IT teachers' interviews

	Discourses	Interaction order	Historical body
Teachers' perceptions of the IT field	Versatile, good employment and salary. Gendered. Women can provide different perspectives	Read news about IT field, discuss with friends employed in IT to update knowledge	Minor studies in IT, few teachers have work experience in IT field
Teachers' IT experience	Technology is a tool that enables new ways of doing things. Education is digitized, learning to use new tools takes time. Students can be resistant	IT teachers support staff and students. IT support person usually male. Students may need a lot of support	IT use expected in national curriculum
Teachers' views on students and IT	Natural sciences are popular and fill the schedules. There is no final exam in IT that benefits applying to universities, so IT is not chosen	Students see teachers take on gendered roles with IT. Teachers can influence with example and encouragement, providing information about work life in different fields and offering experiences	Students use IT for social media and entertainment. Most lack basic computer skills; few are very proficient. IT an 'extra' subject in high school, courses offered but rarely taken

whose role is to help other staff and students in technical matters in addition to teaching the courses. A woman said, "*although I am the most highly educated person in IT in this building, I don't do anything with IT.*" (ITT4) A man reflected "*the gendering is clearly visible in our work community, as the teachers interested in the subject are mostly men. Now we have a few women too.*" (ITT2) This teacher saw gendering in taking on certain roles "*it's not that they say, 'come help me because I'm a woman,' but the hidden message is there if they take the role that they don't need to know how to do things.*" (ITT2) In addition to providing an example, the teachers thought they can influence students through encouragement and information, and that it is not too late in high school. One of the teachers saw it as her duty to tell students about work life, while the other four said they answer questions if students come to them.

The teachers said students find information about careers from teachers, guidance counsellors, events, family, friends, and websites. When it comes to talking about work life, a teacher said, "*most teachers don't have experience from different fields.*" (ITT4) We also asked what kind of discussions the teachers have with students, "*if they ask about jobs, what jobs are like and what they could be, then maybe I'll answer myself. If they ask about studying, I know some things about it but will quickly refer the student to the study guidance counsellor*" (ITT3) They said they can make suggestions; "*You can suggest like 'have you thought about this?', because they have quite a narrow view of*

careers." (ITT3) The teachers saw the importance of IT skills in any profession but were skeptical whether the students see the need. The teachers all had an interest in following news about IT. All knew people working in the field, providing some insights into what the work is like currently.

Teachers' Historical Bodies Influencing in the Background. All the IT teachers we interviewed had studied math in the university, with varying amount of studies in IT; one had taken some courses, three had a minor in IS, and one had an engineering degree in IT - and later studied math to become a teacher. The teachers had teaching experience of 5/8/10/13/18 years in high schools, their courses including firstly math, physics, and chemistry – and IT when possible. In addition, they may train the other teachers.

Teachers Views on Students' Relationship to IT and the IT Field: The IT teachers thought students' IT skills vary; some may be quite proficient due to their interest, while most students' IT use is limited to mandatory schoolwork and entertainment – resulting in lacking basic skills: "*They don't know how to use computers; they just know how to snapchat.*" (ITT4) The teachers in this study said most of their students are studying advanced math and natural science, in which girls do well – deducing that it is not math but technology that the girls are not into. As IT studies (e.g. programming) will be included in earlier education, the teachers anticipate that future students will be more skilled in IT. This would mean less time spent on basic computer skills, and the teachers could do more 'interesting' things during the classes. Using computers is mandated in Finnish high schools, and IT courses can be offered as free choice studies. The teachers have the freedom to choose what they teach and how they teach these courses, but they have little time to develop new methods or content. The available IT courses were currently told to include using software systems and tools (e.g. Windows and Word), but also programming and video and image editing. Few students are taking IT courses, though, as the students focus on the subjects they will take matriculation exams in (which provide entry points to university studies). The teachers felt the students' views of career options are limited and the exams limit them further.

5   Concluding Discussion

This study was motivated by the current shortage of employees in the IT field, particularly by the lack of women. Even if one may argue the problem in IS is alleviated by the field being the 'soft' side of IT, we argue the problem has not been alleviated enough. The difference between IS and IT seems to be unknown to senior high schoolers making their major and career choices – and the IS field still suffers from a lack of women [49]. Therefore, the gender aspect was brought up in this study and we asked as our research question *how do senior high school girls perceive IT and the IT field, and what seems to be shaping their career choices*. We examined these questions from the perspective of senior high school students and IT teachers. This study contributes to IS research on gender and IT by outlying novel, surprising findings involved with young people's career choices to study IT/IS. We contribute to IS education literature by identifying a number of aspects to be considered when trying to encourage girls to study IT/IS.

IT use and Experience Does Not Bring Increased Interest in IT Career for Girls.
Our findings reveal surprisingly strong gendering and segregation in the data, manifesting in a variety of ways in high school students' historical body. We wish to point out that girls in our study saw IT and IT use as gender neutral but the field itself as masculine and unattractive (see [6]). Nexus analysis guided us to study the historical bodies of high schoolers. Even if the use of IT seems to be quite similar – and extensive – for both genders, this did not lead to both boys and girls to consider IT field or IT career the same way. Hence, even if this generation can be considered to represent true digital natives [67], a very traditional and gendered understanding of IT field still prevails (cf. [63]). Unfortunately, particularly girls seem to have a negative perception of IT careers: IT careers are not interesting (see [30]) and they cannot fulfil girls' work values (see [36]) even though girls play video games, use social media, and IT is an everyday tool for them. Hence, it seems that increased, if not extensive, historical body in IT use does not lead to increased interest in IT careers. Our data also indicates that attaching too much importance to IT use might even strengthen the negative perception of the IT field, as girls do not want to 'spend their time on the computer'. Perhaps this focus on IT use overemphasizes IT and computers as complex and technical tools, instead of viewing them as multifaceted IS systems embedded in various social practices (e.g. work and leisure) supporting diverse, sometimes even value-sensitive aims. Interestingly, 'too much IT use' was not considered a problem in relation to doctors, lawyers, or business professionals. Thus, perhaps this tool-orientation has eclipsed the various meanings and purposes of IS enabled ecosystems and we should find new approaches to introduce IT/IS field as a creative field of design and social problem-solving with the potential of emerging new, yet meaningful social practices of everyday life. Instead of considering IT (non)use and (in)experience as the only explanations for exclusion of girls in IT, we should examine the role of IT in the entire educational journey from the viewpoint of what kind of perceptions it imprints on students. Attaching too much importance to IT use and experience will only limit the way we understand this gender-biased phenomenon of exclusion of girls in IT.

Discourses in Place Stereotypical and Non-informative on IT Careers. In our data, students in senior high school did not know IT professions nor were they introduced to those well enough during their studies. They were surprised about the diversity in the field. Perhaps this is also connected to the way IT is introduced in high schools, at least in Finland. Use of IT is compulsory for all, making everyone relatively competent users of IT. However, everyday use of IT does not mean that the students are tech savvy – often their IT use is limited to entertainment (social media, games) and schoolwork (Microsoft Office). This does not seem to increase confidence in IT skills. More advanced courses in IT are optional and those do not tend to interest girls. Girls assume programming skills are needed before entering higher education in IT, which deters them from enrolling. This is not surprising as, after all, inclusion of programming in school curricula is increasingly discussed and thus programming can be overemphasized in relation to IT field. Again, this behavior repeats and contributes to the prevailing stereotypes. Therefore, it is important to break these stereotypes early on. Perhaps the 'softness' of IS field needs to be reconsidered as well. Rather than taking into focus how 'soft' or 'technical' the IT/IS fields are, we should highlight the demanding, socially

challenging practice of the IT professionals when communicating and reconciling the oftentimes conflicting demands of humans in various life situations (e.g. professionals on various fields, children, or elderly).

Teachers Trying to Make a Difference. Teachers may have a minor or a major in an IT subject but are usually firstly math teachers. IT courses may be offered but they only take place if students are enrolling. The high school course topics are basic computer skills in software use, programming, image and video editing. Teachers see the stereotypes and think their students are affected by them and try to convey a more realistic view of the field. Teachers think students' skills are lacking as they use IT mainly for entertainment, and they see this as a problem and that students need to learn computing no matter what field they end up in. Interestingly, no gender was mentioned here (see [29]). In addition, the teachers thought students have plenty of information about careers, but their knowledge about actual work life is limited. The teachers see that the girls themselves choose not to take IT courses, but also recognize the cultural and societal aspects that guide that choice. Teachers saw gendering in personnel who are interested in and teaching IT. While earlier studies have suggested that we should reduce the emphasis of math when speaking of IT [5], these IT and math teachers tend to try to motivate their students by telling the students why the subject is important in any field. It seems like math is not an obstacle based on what students and teachers said, it's the image of the IT field. Teachers think they can influence students through encouragement, example, and inspiration, and that it is not too late in high school (in line with [73]), but they did not mention the expectations they themselves set to their students (see [65]).

Gendered Interaction Orders Among Different Actors Shaping Girls' Interest in IT Careers: Expectations, Norms, Upbringing. Regarding interaction order, our data shows that our society, teachers and parents among others, play a role in gendering and segregation: they seem to have and advocate surprisingly gendered discourses, expectations, norms, and upbringing practices. Even if the students explained that everyone is expected to be able to select any career and pursue their interests freely, they also expressed very traditional and gendered career choices, girls preferring social, caring, and creative aspects, boys showing interest in technology (see [6, 16, 22, 29, 30, 44]). The students revealed that different expectations are placed on boys and girls in families and teachers may in subtle ways engage in gendering practices, hinting things that are specifically of interest to boys or girls. Our findings also suggest that males seem to introduce girls to IT (see [53, 55]). In schools, males seem to take responsibility of IT. Perhaps all this reflects the decades old male-dominant culture of the IT field in general (see [12, 54]). Since the entire IT field is known to be male-dominant, girls may unconsciously feel they need males to mediate their interest and orientation into IT. The girls also felt that the general discourses, media, and game advertisements are directed towards boys, so not much has changed in over 25 years [56]. This study corroborates the findings of existing research on the influence of society, family, and teachers on young people's career choices, including IT careers. It is surprising to find these to remain true, as the world has drastically changed through digitalization.

Vicious Cycle of Gender Segregation Upholds Itself. Based on our findings, we deduce that all the life experiences in relation to IT before choosing the major seem to

play a significant role in this persistent exclusion of girls. Career choices seem to reflect not only young people's perceptions of the field but, perhaps even more importantly, the perceptions of some influential others, thus repeating the same old gender-biased views over generations: stereotypes, educational prejudices, assumptions about antisocial professions, etc. Girls' unfamiliarity of the IT field and career options makes room for influential others to have their say and thus keep the 'rat race' ongoing. We are in a vicious cycle with gender segregation in IT, particularly in the post-industrial nations such as e.g. Finland [30], the context of our study, as segregation upholds itself. Girls need role models, for example their own mothers, to consider IT field as a potential career choice. However, mothers are mostly in social/care fields. Guidance counsellors and teachers in Finnish high schools are also often women, and IT support persons typically men, and it seems that this repeats the gendered culture of women working in 'soft' professions and being less competent in IT. Encouragement and exposure [70] to the field among high school girls falls short if the social environment within the school context provides no role models. Due to lack of role models, girls do not choose the IT field and thus new role models for the next generations will not appear. To break the pattern, we need to make the women already in the field more visible [54]. Luckily, two of the interviewed IT teachers in our study were women, providing some role model for their own students. One problem is that girls think that being 'the only girl' would be lonely and socially isolated [11, 17]; we also need to increase networking between women in the field.

Exclusion and Educational Inequality. Our data indicates that girls voluntarily and intentionally exclude themselves from IT field – it is their choice (see [31]). We must also acknowledge that there are significant cultural, historical and social factors in the background, leading girls to choose this way. Nexus analysis indicates that current societal discourses, interaction orders among significant others around us, and all our historical bodies are always intermingled with our choices [52]. In research on gender and IT, earlier the focus was on intentional exclusion, while more recently the focus has changed to second generation gender bias, i.e. invisible barriers for women in IT that are based on cultural beliefs and workplace structure [51]. The girls in this study were clearly aware of the contemporary (negative) ways of talking about the IT field and professionals. They recognized that they are being shaped and influenced by their parents and their teachers. They seemed less aware of their life experiences and histories shaping their choices. This should be made more visible for the girls, we think. Regarding inclusion and exclusion, we recognize that IT is not a perfect major or career choice for everyone and exclusion from this education may be intentional and desirable for some (cf. [31]). However, exclusion of girls to such a large extent in the design of our digital futures is alarming and we must act to change that.

Our Findings Offer Valuable Insights for IS Education. We need to act and combat the digital divide to achieve equality in education. Based on the study, we identify the following as critical issues: 1) We must enter the education of young generation early on – well before senior high school as many critical choices have already been made before that phase; 2) We must make the IT field and its versatility, particularly the IS field, visible for young people; 3) We must make visible how society is still gendered and

segregated – making this visible may encourage young people to question and alter the traditional ways of doing and thinking; 4) We must identify positive role models for girls in IT/IS: we need to consider what we already have and what could arouse girls' interest and admiration; 5) We must connect the field better with young people's interests, values, and desires – the IT/IS field is not in conflict with those, but the young generation does not seem to see it. IS community needs to address this problem and, building on the accumulated understanding of what keeps women away from the IS/IT field, show girls the versatile career possibilities where it is possible to fulfil various kinds of dreams, desires, and values (see [36]). We also need to remember that it is not only girls who are needed in the IS/IT field and it is not only girls in the post-industrial society who want to fulfil their dreams; we also need more boys to consider IS/IT as their career choice due to the shortage of workforce in IS/IT field. High schools and universities could work together to provide relevant and meaningful activities, with information about different career paths in IT. Further considerations are needed on how IT is integrated in education or what should be included in the IT courses. The current structure at least in Finnish curriculum seems to exclude IT as an 'extra subject' that provides little in terms of meaningful experiences.

Limitations and Future Work. This exploratory study is limited by the sample size. Next, we will interview more girls to get a more thorough understanding of girls' views of the IT field and factors shaping their career choices. In addition, we plan to collect and analyze data from women who have already entered the IT field. We will offer a more nuanced picture of girls and women in relation to IT. This analysis concentrated on summarizing the views of the informants, focusing on commonalities. Through this, we managed to show the surprisingly strong gendering and segregation still ongoing in our society. Then again, we strongly believe there are individual differences [62] among girls, and that there are other dividing factors than gender. We will pay closer attention to these aspects in our future analyses. In our project, we do not assume that girls are only interested in the soft side of IT neither do we want to push girls that way; instead, we want to give a versatile picture of the IT field to all senior high school students, boys included. It is important to note that drawing conclusions to IT/IS field in general is not possible based on our study; IT field covers such a variety. We can point out that at least in Finland, senior high school students do not see any difference between IT and IS and there is obviously a lot that could be done to help them in making well informed and meaningful career choices.

To Conclude, This is Quite a Surprising and Sad Story on How Finnish Society is Still Gendered and Segregated as Regards IT as a Career. From this nexus analytic inquiry, we can see that surprisingly gendered understandings of the IT field and career choices are still prevalent among the studied young people, and this supports educational and occupational segregation. Exclusion of women from IT education, be that intentional or unintentional, conscious or unconscious, accomplished by the excluded themselves or by others [31] indicates a potential for deep digital divide [47], especially from the perspective of people's abilities to make and shape digital technology, not only to use it [31]. Our findings concern post-industrial nations where people choose occupations that they find highly interesting and they would love to do [16], and in many studies it

has been found that girls see IT as boring and unfulfilling for their work values [30, 36]. On the bright side, the teachers see they can make a difference in high schools.

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