

Perceiving ICT: Factors Influencing the Selection of Information Systems as a Major

Joni Matias Rajala

University of Oulu

Oulu, Finland

joni.rajala@oulu.fi

Netta Iivari

University of Oulu

Oulu, Finland

netta.iivari@oulu.fi

Marianne Kinnula

University of Oulu

Oulu, Finland

marianne.kinnula@oulu.fi

Dorina Rajanen

University of Oulu

Oulu, Finland

dorina.rajanen@oulu.fi

Tonja Molin-Juustila

University of Oulu

Oulu, Finland

tonja.molin-juustila@oulu.fi

Abstract

There is a shortage of employees in the Information and Communication Technology (ICT) field, including Information Systems (IS). Student recruitment is a challenge in IS in many countries despite different student marketing efforts and extensive research on the topic. We conducted a survey with first year students in a Finnish university to understand what factors seem to affect their career choice. Our findings indicate that ICT students mostly share their view of ICT with other students, with the exception that they seemed to see the field as more creative, and people oriented. We highlight the creative aspects of the work in IS to potentially attract new students, including more women, to study in IS.

Keywords: Student Recruitment, Choice of Major, IS Enrollment, Creativity

1. Introduction

Information and Communications Technology (ICT) industry is prospering due to the ongoing digital transformation. However, there is a shortage of employees. For example, the International Labour Organization (ILO) [18] forecasts in their latest report an acute shortage of labor force in the ICT field in Canada, China, and Germany. Skills mismatch and gaps, and shortages in skills needed are seen in many countries (see e.g. [18]). In the European Union (EU) area, 55% of companies recruiting ICT professionals had difficulties in 2019 [17]. It is even forecasted that talented professionals will be critical in reaching the EU ambitious goal of “a human centered, sustainable and more prosperous digital future”, but the global competition of these talents will be fierce [11].

Increasing the intake of educational institutes can be an effective way to educate more professionals, but that is not helpful if there are not enough applicants interested in ICT as their future career choice. A colorful range of techniques is used to attract new students, for example marketing campaigns [15], campus visits [22], company visits [13], and workshops [21]. The aim for most of these programs is to change how potential applicants view higher education institutes or the study programs that participate in these efforts. The

problem of student recruitment has persisted for a long time regarding the ICT field, and it looks like the problem keeps persisting, as the number of jobs has risen in the last decade [12], but universities have not managed to keep up with their intake [24]. There already exists a huge literature base on why students choose ICT¹ majors [32]. The reasons include things like previous experiences, personal interests, influence from family and friends, and students' perception of career possibilities [25].

The problem of student recruitment and factors affecting IS major choice have been examined also in the Information Systems (IS) field [20, 29, 30, 34]. Interestingly, studies have found that one of the biggest downfalls of IS marketing comes from its assumed technical and mathematical nature, and from the subject seen as a male dominated nerdy field [20, 27]; hence, the same aspects that are seen to characterize ICT are associated with IS as well [20, 30, 31]. These problems are pronounced in relation to girls' major choice and girls not showing interest to apply to the field [3, 28, 31]. Important to note is that there are differences in the positioning of the IS in universities globally. This study makes visible the unclear positioning of IS in Europe, in which IS is variably located in business schools or in ICT or natural sciences faculties. In our Finnish university, IS was previously located in the faculty of science, while it is now in the ICT faculty. We have a degree program with a curriculum that combines IS and software engineering (SE), equivalent to Swedish 'informatik' or German 'informatics'. When located within ICT faculty, the technical and mathematical nature of IS may become underscored rather than the business, organization, design or human oriented nature, as students have had problems perceiving the difference in previous studies [27]. Then again, the studies have shown that the same problem prevails also in IS in US [3, 20].

One way to market IS to potential applicants is to change the perception they have of the field and fix the potential image problem that faces the field. However, this relationship between the image problem and applying is rather complicated. If we consider that there is an image problem within IS and related fields, i.e., that such an image exists that prevents some students from applying who would have otherwise applied, it suggests that students either believe in an untrue image of the field, they have a narrow view of the field in general, or they are not interested in IS and related fields despite any kind of image. However, at the same time there are also students applying to IS or related fields, so those students either see the "problematic" image of the ICT field as something they want, or they might have a different view of the field. The image of the IS and related fields anyway has some kind of an effect when students select their major.

In the current study, our aim is to understand which views are prevalent in the Finnish academic enrolment, and how those views shape students' enrolment. In order to gather data on this topic, we created a survey for all the first-year students at the University of Oulu in Finland in October 2021, regardless of their major, asking about their perception of work in the ICT field and their reasons for choosing their own major. We compared those results to what they are currently studying. As for the ICT field, we focused on work relevant from the viewpoint of our degree program (IS and SE), i.e., work in software industry, excluding work on hardware and telecommunications that are more relevant for other degree programs of our ICT faculty. It is likely that some respondents do not know the difference between these, we chose to be strict with the terminology and measure the students' perception of software industry. The data is used to answer the following research questions: 1. *Do new students' perception of work in ICT affect their choice of major?* 1.1. *Do new ICT students' perception of the work in software industry differ from the perception of new students of other majors?* 1.2. *Do new ICT students value the prevalent perceptions of the work in software industry more than new students of other majors?*

¹ We use ICT major in this paper as an umbrella term to cover various computing related majors: software, hardware and telecommunications related ones, including Computer Science (CS), several Science, Technology, Engineering, Mathematics (STEM) majors as well as Information Systems and Software Engineering (SE) majors, of which the former represents a heavily business, organization, management and user oriented major

The paper is structured as follows. Section two introduces related research. Section three presents the research design, including the participants and procedures for data collection and analysis. Section four presents the results while section five discusses their implications. Section six concludes the paper.

2. Related Research

There is plenty of literature on factors affecting students' major choice, trying to figure out how to attract students to majors. Such literature is extensively produced within ICT field [5, 14, 25, 32], including in IS [3, 10, 19, 20, 28, 33]. The literature shows different kinds of historical, social and discursive factors as affecting the major choice in IS: different kinds of stakeholders have strong impact but also personal interests, attitudes and experiences in ICT derived through education as well as through other encounters with ICT, not to mention the influence of societal level images, stereotypes, norms and discourses [27, 28, 31]. One problem when making the career choice is unfamiliarity with what work in the IS field entails in practice [1, 13] and unclarity of how different ICT majors differ from each other [7, 16, 28]. However, one study found that job expectations between ICT majors and non-ICT majors did not markedly differ [2].

Several prior studies have indicated the impact of existing beliefs or perceptions of the field or of the professionals working in the field on students' major choice [3, 10, 20, 33]. A general interest, even fascination of the work in ICT field has been found – not surprisingly – to be a huge motivation to choose an IS/ICT career [8]. A belief that one's own work values match with IS careers as well as positive encouragement towards that specific career particularly from someone close to the person have been found to have a positive effect [19]. High demand of workforce on the ICT field has been found as a motivating factor [8]. Self-efficacy, that is, high confidence in technical abilities, has also been found in many studies to increase the likelihood in choosing an IS/ICT career [1, 19]. Particularly perception of abilities to learn programming can have an effect [19] but also technical capital in general [8]. On the other hand, unfortunately, even extensive ICT use does not necessarily lead into an increased interest in IS career [28].

Following these studies, we will inquire the perceptions new students have about the work in the software industry. In this study, we particularly build on the study by Downey and colleagues [10] who have examined factors affecting students' major choice in IS and CS. However, we complement their study by examining some additional stereotypes of the work in software industry that have already been reported in the literature.

The significance of stereotypes has been acknowledged to affect the students' major choice in the ICT field [5, 33], including IS [27], although differing findings also exist [19]. Positive and negative stereotypes have been studied a lot, often from the perspective on how stereotypes negatively affect girls applying to ICT field [5], with very similar results to the IS field [27, 28, 31]. According to these stereotypes, these fields are male dominated, technology focused and solitary pursuits. There are also similar stereotypes on how these fields are math intensive, and only geniuses can succeed in them. Or you need to at least be a dedicated nerd or a gamer. The stereotypes often are negative and self-enforcing, in that if people do not see any visible contradictions to these stereotypes, only students who value those stereotypes pursue a career in these fields. Furthermore, as boys see these as male dominated fields, they may act in a way that makes girls feel unwelcome. Moreover, student councillors and teachers might not think that a girl might want to study ICT, and never even offer it as an option for girls. These stereotypes and views are often formed from media, peers, teachers, and family. In IS specifically, the influence of family on students' perception is quite pronounced. [5, 27, 28, 31, 33].

First year students in universities (ages 18-25) are typically at the development phase of 'emerging adults' [4], i.e. between adolescence and adulthood. In this phase, adult roles and preferred occupations are emerging and social norms, i.e., customs within a particular society, have a great influence. For example, gender is an important factor, and if something is considered as a way of being a (wo)man, it affects one's behaviour [4].

3. Research Design

This research was conducted as a survey for the first-year students at the University of Oulu in Finland in October 2021. As the aim of the survey was to find out how students' perception of software industry related to their major selection when applying to study in the university, it was important to send the survey to students from all majors, to be able to compare the answers between student groups. In order to make sure that the study respondents' perceptions of the field actually presented their views during enrolment and application process, the survey was only sent to the first-year students, who had only been students for less than two months when the survey was conducted. If the participants had been students for longer, there is a risk that their perception of the work in the software industry might have changed [20], or they might not remember the reasons for why they applied to their selected major. Compared to countries where higher education students can choose their major after few years of studying, university students in Finland must choose their major when applying to university. This means that the survey was conducted on students who already had made the choice of major about 4 months before the survey, when they decided whether they take the offered study place or not.

The questionnaire was sent to a common mailing list for all university students, with clear instructions that the survey was meant for the first-year students of all majors, and it measured their perception of software industry and factors that affected their selection of the major. All questions were in Finnish. In addition to the student mailing list, the survey was sent by email to all students taking an introductory course on Information Systems and Software Engineering to obtain large enough sample of students from our IS/SE degree program to which other students could be compared.

The survey questions were created to map the participants' perception of the work in software industry. Questions were assembled from previous survey questions aimed to map reasons why students applied to the IS field as a major [9]. Additional questions were identified to map other possible views found in literature. Negative views, such as the view of the ICT field as a solitary field had not been measured in any previous survey, so they were included from sources that discussed IS stereotypes in general [6]. Before sending the questionnaire to the mailing list, it was piloted by sending it to five students. This led to small phrasing changes. The survey had three major parts, in which participants assessed their agreement with various statements using five-point Likert scale. The first part asked all respondents how they saw statements about ICT to fit the work in software industry. The second part asked students who were not studying software industry related field how those same statements matched their current selection of major. This part contained instruction to not answer these questions, if they were studying in software industry related field, as they already had given their perceptions in the first part. For analysis, if they did not answer this set of questions, the respondents' answers were copied from their views on the software industry. The last part asked all students to assess to what extent those views were the reason they applied to their major. In addition to these major parts, background information was gathered to categorize students and make sure the data came from first-year students. The questionnaire contained questions on age, year of admission, current and applied majors, and whether their current major was their first major. In addition, there were questions on students' previous experience in ICT (previous work experience in software industry and if they knew anyone who worked in software industry).

The survey was sent to the mailing list twice, with one week interval between the initial posting and the reminder. After the reminder, the students were given two weeks to submit their answers. After the data was collected, it was prepared for data analysis. The Likert scale answers were mapped for analysis to values between -2 and +2, where +2 was "I agree" and -2 was "I disagree". Because the questionnaire was sent to a student mailing list, we had to filter out students that had studied for more than a year. Only data from students that had begun their studies in 2021 have been analyzed. The number of respondents per major typically varied between 5 and 15, but three majors had more respondents, namely IS/SE (our own study program) (49), CS (24) and medicine (34). Because of the small number of answers per major and to focus on the ICT related majors, students were grouped by faculty, and the analysis was done by comparing faculties. This

grouping was also possible because the University of Oulu has an ICT faculty. Thus, for the data analysis, all ICT students were in one group and there were no ICT students in the other groups.

The data was analyzed using Mann-Whitney U test to compare students' perceptions and reasons by faculty, as the data was not normally distributed. Each survey question was analyzed separately from each other. Each faculty was compared against the ICT faculty separately and as a group to find the differences of perception between them. The majors in the ICT faculty include electrical engineering, telecommunications, CS and IS/SE. As many studies on students' perception of IS as well as on ICT in general focus on women and girls, and their enrolment is important, special attention was paid on women's perceptions.

4. Findings

4.1. Frequencies

The survey gathered 360 responses in total, though 64 of them were from students that were not first year students, and two had not answered all necessary questions, so they were removed from the data set. Thus, 294 first year students answered the survey, which is 13% of all 2230 students who enrolled in 2021. This is quite low figure for responses. The responses by faculty are shown in Table 1.

Table 1. First year students' responses by faculty and by gender.

Faculty	Man	Woman	Other / No answer	Total
Human Sciences	7	35	3	45
Education	0	28	0	28
Business School	6	8	0	14
Natural Sciences	12	20	2	34
Medicine	10	38	0	48
Engineering	20	22	3	45
ICT	60	18	2	80
Total	114	170	10	294

Comparisons are done on the faculty level, as most majors had only a handful of responses. The ICT field was represented by 80 students, who account for 29.6% of all 270 students that enrolled to the ICT faculty in 2021.

The survey also checked which majors the students applied to, in order to see if the students were interested in studying IS/SE even if they had enrolled to some other field. However, the responses showed that basically no one had applied to IS/SE unless they also had selected it as their major. There were only 14 students that were not IS/SE students, but had applied to it, and those students were quite evenly split between the faculties.

4.2. Differences Between Faculties and Genders

There were no big differences between genders in their views of software industry. All mean differences (md) between the answers were less than 0.45. The biggest differences were that men saw the field as more human centered (md=0.43) and creative (md=0.41), when comparing to women. When focusing on ICT students, the differences between genders disappeared almost completely. The only difference was that women viewed software industry as more difficult (md=0.44) than men. When examining ICT students' reasons for applying to their major, the differences between genders was again minimal. The only differences were that women agreed more with the statements that they applied

to their major because it was challenging ($md=0.9$) and prestigious ($md=0.8$).

The analysis show that the ICT students viewed software industry as more people oriented than the students from other faculties (mean difference between 0.5-1.2 and always $p<0.05$). The same difference in the view of the software industry as a solitary profession was not found, as the ICT students had similar perception to other faculties, with the exception of medicine ($md=0.81$ when compared to ICT) and business school ($md=0.87$ when compared to ICT) students, who viewed software industry as more solitary than anyone else. Interestingly, even though the ICT students viewed their field as more people oriented than other students, students from other faculties viewed their profession as more people oriented than the ICT students viewed software industry, with an exception among the responses from the students in natural sciences.

Even though the ICT students viewed the field as more people oriented than others, the students did not value the social aspects as much during their major selection, especially compared to education ($md=1.68$ & $p<0.001$), business school ($md=1.06$ & $p<0.001$) and medicine ($md=1.37$ & $p<0.001$) students. Even more drastic was the perception of software industry by the ICT students against engineering students, where ICT students viewed it as more people oriented ($md=0.7$ & $p<0.001$) but they also viewed it as more solitary ($md=0.4$) and agreed more with the statement “I selected this field because I can work alone” ($md=0.6$).

Table 2. Means from each faculty to the questions “In software industry the work includes working with people”, “In my current field the work includes working with people” and “I applied to my major because I wanted to work with people”. ** marks $p<0.01$ when compared to ICT using Mann-Whitney U test; * means $p<0.05$.

Faculty	Software industry is people oriented	Their chosen field is people oriented	Working with people as a reason for applying
Human Sciences	-0.01*	1.31*	0.14
Education	-0.11*	1.79**	1.55**
Business School	-0.36**	1.54*	0.93**
Natural Sciences	0.09**	0.61	-0.09
Medicine	-0.33**	1.76**	1.24**
Engineering	0.11**	1.25*	0.36*
ICT	0.81	0.38	-0.13

Another important distinction between the ICT students and students from other faculties is that the ICT students viewed their major as creative, and somewhat applied to ICT because of it. Only engineering students had statistically significant and positive difference in their view of creativity as a reason for applying.

Table 3. The means for question “The software industry is a creative field”, “My field is a creative field” and “I chose this field because I want to do creative work” from the students from each faculty. ** marks $p<0.01$ when compared to ICT using Mann-Whitney U test; * means $p<0.05$.

Faculty	Software industry is creative	Their chosen field is creative	Creativity as a reason for applying
Human Sciences	0.69*	0.24	0.41
Education	0.68*	1.10	0.72
Business School	0.43**	0.36	-0.21**
Natural Sciences	0.76**	-0.01	-0.21**
Medicine	0.77**	0.00	-0.33**
Engineering	0.85*	0.88	0.88
ICT	1.2	1.12	0.54

The most common reason for the ICT students for selecting their major was their interest in technology, computers and mathematics. These were all separate questions in the survey, all of them were clearly shared by ICT students. While those interests are often cited as stereotypes that hinder girls from applying to the field [5], it is also clearly the most common reason students apply to the ICT field. When compared with the results that ICT students valued creativity, this seems to indicate that ICT students wanted to work in a creative field, and they understood that there is creativity involved in the work in the ICT field.

ICT students were also an interesting outlier in that they represented the only faculty where the students did not choose their major because of the information provided in secondary education as shown in Figure 1. In every other faculty the results for the question “I chose this my field, because the perception I got from it in secondary education was good” the results followed even distribution, with slight emphasis on the positive results, but a quarter of ICT students strongly disagreed with the statement. The differences were big within all faculties, with mean differences going up to 1.14 for medicine and 1.05 for engineering. The other faculties were not far behind with mean difference of human sciences at 0.85 and natural sciences at 0.96. Education ($md=0.55$) and business school ($md=0.48$) did not have significant differences, but their results were still more positive than for the ICT faculty. In addition, when comparing all non-ICT students with ICT students the mean difference stays at 0.91.

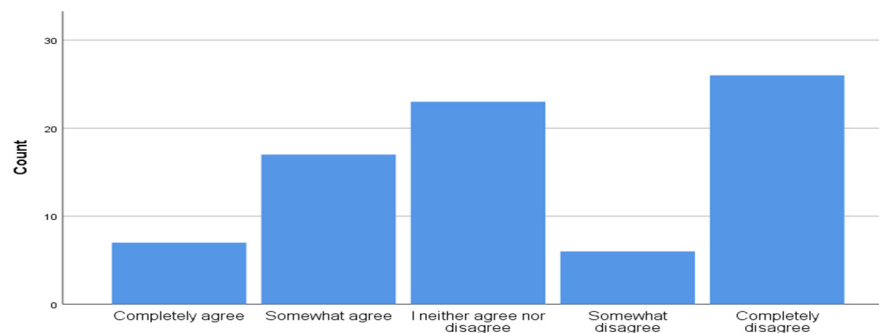


Fig. 1. Bar chart for ICT students answers to question “I chose this my field, because the perception I got from it in secondary education was good”.

There were no big differences between view of software industry of ICT student and others. The differences between the views on whether software industry has higher salary, long workdays or if the field is prestigious did not change between faculties to be statistically significant. All answers were also quite equally distributed and mean values among all students close to 0.5, with high salary ($mean=0.80$) and prestige ($mean=0.73$) a bit more on the positive side and statement that “software industry has long workdays” ($mean=0.33$) a bit more on the negative side. The ICT students did find higher salary as a more important factor when applying compared to other students ($md=0.61$), but that was highly dependent on the faculty. Education ($md=1.54$), human sciences ($md=1.30$) and natural sciences ($md=1.43$) all did not value salary, whereas there was no statistically significant difference between ICT and business school, engineering, or medicine students.

5. Discussion

This study focused on students’ major choice and their perceptions of the ICT field, more specifically of software industry. It is a widely known and long-lasting concern that young people have problematic perceptions of the ICT field, including the IS field. Hence, it is important to understand what kind of perceptions the young people of today have of the ICT field as well as to understand factors they value in the field they choose to study. This study provides important insights in this respect. We generated two alternative propositions in the introduction regarding students’ major choice: that students who apply to IS or related fields find the stereotypical image of the fields as something they want, or that they have an alternative view of the field. We found empirical support for both propositions.

General view of the field. Previous research guides towards examining the existing perceptions of the field or of the professionals working in the field [3, 10, 20, 33]. At large, there seemed to be no difference in our data on how the students perceived software industry, i.e., both those majoring in ICT and those majoring in any other field saw software industry similarly. There was no clear difference between genders either. These are somewhat surprising findings, but also positive ones, telling us that at least the general image of the industry is not problematic as such, at least among the respondents in the Oulu area, and the reasons for career choice are somewhere else than in a negative general image.

Social aspects. A clear difference between the students was that the ICT students viewed working in software industry as more people oriented than the other students. However, social aspects were not considered especially valuable by the ICT students in their career choice, i.e., they did not choose their major based on social aspects, and they actually saw the possibility to work alone as an asset of the work in software industry. These findings follow a pattern found previously [10] that ICT students understand that interaction is inherent in the field, but they do not necessarily seek interaction from customers or people outside of their group. The same logic can also explain why this study found that ICT students apply to their field because they can work alone.

Creativity. An interesting new finding compared to previous research is that the ICT students saw working in the software industry clearly as more creative work compared to other students, and cited that as a reason for applying in the field. This has not been previously identified as a factor related to the IS or ICT career choice. This finding indicates the ICT students may have a better understanding of what kind of creative aspects the work in the ICT field can contain, compared to other students, as indeed, creative process is at the core of the work in the IS field [23, 26] and in the ICT field in general. This finding indicates that the ICT students want a creative pursuit, and thus they select the field that they see as a creative one. Thus, if creativity is one of the career choice factors for an applicant, the finding suggests that there should be more focus on making visible the creative aspects of the work in the ICT field in student marketing, as proposed also by Downey et al. [10]. It seems that the ICT students who have applied to the field can see the creativity involved in the work in this field even without anyone informing of that, while there might be many potential students who cannot see the creativity involved in the ICT field yet, but who might get interested in the field if properly informed. Creativity is definitely involved in the innovation, design, and development of digital technology. Creativity is an essential aspect of human and business-oriented work in our field. Informing better the potential students of the creative aspects of our field might make a big difference in the number of applicants, which has been low in many ICT degree programs over the years. Overall, we think we should be digging deeper into the young people's views on creativity: what they think it entails, in different fields, including ours. The students no matter the major seemed to see their field as a creative one and emphasized that in their major selection. It might be that creativity of the work is something that generally attracts the young people of today. If that is the case, we should be making the creative aspects of the IS field much more visible.

Information gained in secondary education. In Finnish secondary education there are student councilors who try to help the students in making their career choice. We know from previous IS research that they have difficulties in understanding themselves the work in ICT field in more general, and in IS field in particular, which naturally hinders their capability to give the students a good view of the field [28, 31]. This might be at least partly behind the interesting finding concerning information provided during secondary education: the ICT students did not choose their major based on the information they had received in secondary education. ICT students seem to lack information of the ICT field, compared to many other fields. This strongly contradicts with the other majors, where the students mostly reported that the perception of their chosen field given in secondary education had been a factor when making their career choice. Of course, there are big differences between educational systems of different countries, but especially in countries in which students need to make their major choice already when applying to higher education, it is critical for us to offer upper secondary students more information of the

ICT field and particularly of the IS field [28, 31]. We also think that informing upper secondary students about the IS field would be valuable even in the case of major selection being made later in the studies, in line with e.g. Downey et al. [10] who also report that high school students are not even aware of the existence of the IS field when making their career choice. We could give high school students more information of what the work in the IS field entails in practice [1, 13], tell how the ICT majors differ from each other [7, 16, 31], and educate pupils during their basic education of this exciting field with career opportunities for those interested in technology and mathematics as well as for those interested in design, people, management and business, not mention all those interested in a career entailing creative work.

Interest in technology, computers, and mathematics. ICT students in our study showed strong interest in technology, computers, and mathematics. This does not come as a surprise, as they are central in the ICT field, and often reported in the literature on IS and ICT career choice [8, 10]. This is also in line with the stereotypical view of the field, especially when combined with the fact that the ICT students did not value social aspects a lot in the work. It can also be linked with ICT self-efficacy and technical abilities [1, 19], particularly programming [19] and other technical capital [8]. However, important is also to remember that previous research has shown that technical capital does not necessarily lead to interest in the IS career [30].

Then again, the ICT students also produced alternative, non-stereotypical views of the field, as a people oriented and creative work. These people and creativity related reasons might be the reasons why the students who chose other majors did not consider ICT as a career choice, especially as everyone seemed to apply to a field that they considered people oriented. The findings on the interest in technology, computers and mathematics reproduce existing stereotypes of our students, while the findings on the perceptions among the ICT students of the ICT field being people oriented and creative enables questioning the stereotypes. We see that particularly in this respect there are implications for our student recruitment and marketing programs.

If student councilors or university marketing are interested in changing the perceptions of the ICT field in the eyes of future applicants, they could look into how students from other faculties view social aspects, people orientation, creativity and their own career choice. Students similar to them could potentially be swayed if the social, people related and creative aspects involved in the ICT field were brought forward. However, that probably is not enough, as most students who apply to the ICT field still select their field because of their interest in technology. Probably some interest in technology, computers and mathematics is needed from all students who apply to the ICT field. We need more data on how interested the students from other faculties were in technology, computers and mathematics, compared with the ICT students. This survey only asked if the students applied because of those qualities. From these results it is impossible to say, if the students from other faculties were interested in technology, computers and mathematics, but did not choose ICT as their career because of other factors.

Gender. As for gender aspects intermingled with the ICT field, an interesting finding was that the ICT field appeared more human centered and creative for men than for women. However, no clear differences could be identified among the ICT students. Overall, as the differences were so small, we can say that the perception of software industry is shared by both genders. This does not mean that the perception of software industry that first year students have does not favor masculine characteristics, it only means that the perception does not differ between genders. Similarly, the women who applied to the ICT field did not seem to favor any particular set of characteristics that the men did not favor. The women who enrolled to ICT enrolled there because they viewed the field as creative, and they liked working with technology. This means that the perception of technology as ‘a boys’ club’ needs to be changed, if we want to make ICT more gender diverse. This all comes to marketing and visibility of the field in the previous stages of education. Given that the ICT students did not see any value from student counseling or student outreach programs from the secondary education for their major selection, the main reason for their application comes from elsewhere. This survey did not ask about hobbies, which is

regrettable, but if the major is not marketed to them from education system, the main factors likely come from family, peers, hobbies, media and everyday experiences [27, 28, 30]. Unfortunately, the existing literature indicates that the society, including media as well as the people close to these young people, still tend to produce very gendered understanding of the ICT field [27, 28, 30]. If we want to develop an alternative image of the field to attract more women, the silver bullet is yet to be found. Emphasis on the creative aspects of the field might provide one valuable path for future work.

6. Conclusions

Our findings were refreshing compared to previous research as it seems that at least some elements of the old stereotype of ICT field (and IS as part of that) as boring, solitary work have vanished or at least somewhat abated. The findings highlight the fact that choosing the ICT career is very much based on the interest in the field. In our study, the respondents considered ICT career as creative and involving working with people. However, their knowledge of and enthusiasm with the field did not originate from information received during their secondary education. It is almost vice versa: we can provocatively say that they seem to choose their ICT careers despite the information they received during the secondary education, as based on previous research [30, 31] we can assume that they have mostly received information related to other career options and very little related to the ICT career. In line with Downey et al. [10], we propose IS educators to disembark from the higher education institutes and enter the secondary education schools to inform both the students and their student councillors about the IS field as an interesting, creative, and social career choice with great career opportunities and good salary.

As to the limitations of this work, the study was conducted within one university only, and future studies with a larger sample and across different countries would be needed. There is also room to dig deeper into how and why the qualities like creativity and social needs differ between the students that applied to different faculties.

References

1. Alexander, P.M., Holmner, M., Lotriet, H.H., Matthee, M.C., Pieterse, H. V., Naidoo, S., Twinomurinzi, H., Jordaan, D.: Factors Affecting Career Choice: Comparison Between Students from Computer and Other Disciplines. *J. Sci. Educ. Technol.* 20(3), 300–315 (2011)
2. Alexander, P.M., Pieterse, V.: Indications of personality trait difference between ICT and other students. In: 18th European Conference on Information Systems, ECIS 2010. (2010)
3. Andersson, A.: Victim, Mother, or Untapped Resource? Discourse Analysis of the Construction of Women in ICT Policies. *Inf. Technol. Int. Dev.* 13 (2017), 72–86 (2017)
4. Berger, K.S., Thompson, R.A.: The developing person through the life span. *Dev. Pers. through life span* (4th ed.). 697-Chapter xxvi, 697 Pages (2017)
5. Cheryan, S., Master, A., Meltzoff, A.N.: Cultural stereotypes as gatekeepers: Increasing girls' interest in computer science and engineering by diversifying stereotypes. *Front. Psychol.* 6 (FEB), 1–8 (2015)
6. Clayton, K.L., Hellens, L.A.V., Nielsen, S.H.: Gender stereotypes prevail in ICT; A research review. In: Proceedings of the special interest group on management information system's 47th annual conference on Computer personnel research. pp. 153–158. (2009)
7. Courte, J., Bishop-Clark, C.: Do students differentiate between computing disciplines? *SIGCSE Bull. Inroads.* 41 (1), 29–33 (2009)
8. Deng, X., Zaza, S., Armstrong, D.: Factors influencing IT career choice behaviors of first-generation college students. In: 26th Americas Conference on Information Systems, AMCIS 2020. (2020)
9. Downey, J.: An empirical examination of the composition of vocational interest in Business Colleges: MIS vs other majors. *J. Inf. Syst. Educ.* 22 (2), 147–158 (2011)
10. Downey, J.P., McGaughey, R., Roach, D.: MIS versus Computer Science: An Empirical Comparison of the Influences on the Students' Choice of Major. *J. Inf. Syst. Educ.* 20 (3), 357–368 (2009)

11. European Commission: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, (2021)
12. Eurostat: ICT specialists in employment. (2019)
13. Ferratt, T.W., Hall, S.R., Kanet, J.J.: Out of the fog: A program design for understanding alternative career choices: Examples in management information systems and operations management. *Commun. Assoc. Inf. Syst.* 38 (1), 106–121 (2016)
14. Giannakos, M.N., Pappas, I.O., Jaccheri, L., Sampson, D.G.: Understanding student retention in computer science education: The role of environment, gains, barriers and usefulness. *Educ. Inf. Technol.* 22 (5), 2365–2382 (2017)
15. Granger, M.J., Dick, G., Jacobson, C.M., Van Slyke, C.: Information Systems Enrollments : Challenges and Strategies. *J. Inf. Syst. Educ.* 18 (3), 303–311 (2007)
16. Gupta, U.G., Houtz, L.E.: High school students’ perceptions of information technology skills and careers. *J. Ind. Technol.* 16 (4), (2000)
17. International Labour Organization: Skills shortages and labour migration in the field of information and communication technology in India, Indonesia and Thailand. (2019)
18. International Labour Organization: “The Future of the Work in ICT” Project “The Future of Work in ICT” Project contents. (2020)
19. Joshi, K.D., Kuhn, K.: What determines interest in an is career? An application of the theory of reasoned action. *Commun. Assoc. Inf. Syst.* 29 (1), 133–158 (2011)
20. Joshi, K.D., Schmidt, N.L.: Is the information systems profession gendered? *ACM SIGMIS Database DATABASE Adv. Inf. Syst.* 37 (4), 26–41 (2006)
21. Keller, L., John, I.: Motivating female students for computer science by means of robot workshops. *Int. J. Eng. Pedagog.* 10 (1), 94–108 (2020)
22. Kitchen, J.A., Sonnert, G., Sadler, P.: Campus Visits: Impact of a College Outreach Strategy on Student STEM Aspirations. *J. Stud. Aff. Res. Pract.* 57 (3), 266–281 (2020)
23. Müller, S.D., Ulrich, F.: Creativity and information systems in a hypercompetitive environment: A literature review. *Commun. Assoc. Inf. Syst.* 32 (1), 175–200 (2013)
24. OECD: Education Database: Enrolment by field, *OECD Education Statistics (database)*, https://stats.oecd.org/Index.aspx?DataSetCode=EDU_ENRL_FIELD, Accessed: June 14, 2021, (2021)
25. Owuor, J.A.: Examining Female Students’ Motivation and Preferences for Course Choices in an Undergraduate ICT Program in a Californian University. *Can. J. New Sch. Educ.* 1 (2), (2009)
26. Seidel, S., Müller-Wienbergen, F., Becker, J.: The concept of creativity in the information systems discipline: Past, present, and prospects. *Commun. Assoc. Inf. Syst.* 27 (1), 217–242 (2010)
27. Vainionpää, F., Kinnula, M., Iivari, N., Molin-Juustila, T.: GIRLS’ CHOICE - WHY WON’T THEY PICK IT? In: ECIS 2019. (2019)
28. Vainionpää, F., Iivari, N., Kinnula, M., Zeng, X.: IT is not for me - Women ’ s Discourses on IT and IT Careers. In: Twenty-Eighth European Conference on Information Systems (ECIS2020). (2020)
29. Vainionpää, F., Kinnula, M., Iivari, N., Hartikainen, H.: Aiming for Resemiotisation – Meanings Making and Co-Creation of Value Around an IT Course. 1–17 (2020)
30. Vainionpää, F., Kinnula, M., Iivari, N., Molin-Juustila, T.: Career choice and gendered perceptions of it – a nexus analytic inquiry. *Lect. Notes Inf. Syst. Organ.* 39 LNISO 37–56 (2020)
31. Vainionpää, F., Kinnula, M., Iivari, N., Molin-Juustila, T.: Girls in IT: intentionally self-excluded or products of high school as a site of exclusion? *Internet Res.* (2020)
32. Wang, X.: Why Students Choose STEM Majors: Motivation, High School Learning, and Postsecondary Context of Support. *Am. Educ. Res. J.* 50 (5), 1081–1121 (2013)
33. Zhang, L. fang: Do personality traits make a difference in teaching styles among Chinese high school teachers? *Pers. Individ. Dif.* 43 (4), 669–679 (2007)
34. Zhang, W.: Why IS: Understanding Undergraduate Students ’ Intentions to Choose an Information Systems Major. *J. Inf. Syst. Educ.* 18 (4), 447–458 (2007)

Appendix A. Survey Questions translated to English

What is your gender?

Male / Female / Other / Prefer not to say

Your age

18 – 19 / 20 – 21 / 22 – 24 / 25 – 29 / 30 – 34 / 35 or older

When did you start studying in your current degree program?

2021 / 2020 / 2019 / 2018 / 2017 / before 2016

What is your current major?

Is this your first major?

Yes / No

Are you an international student?

Yes / No

What majors did you apply to when you last applied to universities?

Have you worked in the software industry previously?

Yes / No

Do you have anyone in your friends or family who has or is working in the software industry?

Yes / No

Which of the following do you think applies to the software industry?

(I agree/ I somewhat disagree/ I neither agree nor disagree/ I somewhat disagree/ I disagree)

It is hard/challenging work

It is lonely work

It is a prestigious field

The field has high salary

Work includes working with people

Work includes working with machines and technology

It is a men's field

It has long workdays

It is math intensive

You must enjoy working with computers

It is primarily programming

It is a creative field

You can easily get a job after graduating

How else would you describe software industry: _____

Which of the following do you think applies to you current field? (You don't need to answer this question if your current field is software industry)

(I agree/ I somewhat disagree/ I neither agree nor disagree/ I somewhat disagree/ I disagree)

Same subquestions as before

How else would you describe your current field: _____

How the following affected your selection of your current major?

(I agree/ I somewhat disagree/ I neither agree nor disagree/ I somewhat disagree/ I disagree)

I chose this field because it is challenging work

I chose this field because I can work alone there

I chose this field because it is a prestigious field

I chose this field because there is a high salary

I chose this field because I can interact with people there

I chose this field because I can work with computers and technology

I chose this field because there are lot of people of my gender

I chose this field because the field does not require long working days

I chose this field because I like math

I chose this field because working with computers (*Grammatical error was in the original*)

I chose this field because I like programming

I chose this field because I want to do creative work

I chose this field because it is easy to get a job after I graduate

I chose this field because I want to change the world

I chose this field because I got a positive image in upper secondary education

I chose this field because of prior work experience in the field

I chose this field because of influence of friends and family

Other factors that affected your choice of major: _____