TALLINNA ÜLIKOOLI RAHVUSVAHELISTE SOTSIAALUURINGUTE KESKUS

GENDER DIFFERENCES IN ICT TRAINING PARTICIPATION IN INTERNATIONAL COMPARISON

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Rahvusvaheliste Sotsiaaluuringute Keskus (RASI) on Tallinna Ülikooli Ühiskonnateaduste Instituudi sotsiaalteaduslik interdistsiplinaarne teadus- ja arenduskeskus, mis teostab teadusprojekte. RASI teadurid on tegevad ekspertidena ühiskonnaelu analüüsimisel ja kujundamisel. TLÜ RASI uurimisteemad hõlmavad ühiskondliku ebavõrdsuse (või ka kihistumise) erinevaid tahke – sugu, rahvus, vanus, põlvkond, haridus, ametipositsioon. Viimastel aastatel on hakatud suurt tähelepanu pöörama elukestva õppe problemaatikale kui eluteed kujundavale ja sotsiaalset sidusust Eestis ning laiemalt kogu Euroopa Liidus tagavale tegurile. Teine uuem temaatika osakonna uurimistöös on seotud aktiivse vananemise küsimustega.

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1. Introduction

The labour market is in flux affected by a deep and rapid digital transformation as well as a globalization. Promoting a good match between the rapidly changing demand for skills with workers' competencies is crucial to harness the potential of these changes and ensure that no one is left behind (Autor et al. 2003). The ability to use computers is not only becoming an essential skill, but proficiency in computer use has an impact on the likelihood of participating in the labour force and on workers' wages. With the widespread diffusion of information and communication technologies (ICT) in all areas of life, the ability to manage information in digital environments and solve problems that involve the use of digital devices, application and networks is becoming essential for adults of both sexes (OECD 2012).

Surveys commonly find that men use computers somewhat more frequently than women do. Eurostat found that in 2017 81% off men aged 16–74 used a computer in the 12 months prior to the survey compared to 78% of women that age [Eurostat, isoc_ci_cfp_cu]. However, there are quite big country differences: the gender differences are bigger in Southern European countries (for example in Italy 65% men used computers and only 57% of women). Expectations about working in ICT-related occupations appear to be highly gender-biased. In 2018, on average across OECD countries, only 1% of girls reported that they want to work in ICT-related occupations, compared with 8% of boys who so reported (OECD 2018). In addition, the gender gap in interest in these occupations tended to widen over the past few years. The proportion of boys who reported that they expect to work as ICT professionals had increased between 2015 and 2018 by 1.1 percentage points, but the proportion of girls who reported so increased by only 0.2 percentage points during the same period (OECD 2018).

Most research in the 1990s and early 2000s show disadvantage for women in ICT literacy (Jannsen et al. 1993; Kuhlemeier and Henker 2007; Volman et al. 2005). In contrast, more recent studies reveal less consistent pattern. For example, some studies indicate that girls outperform boys in ICT skills (Eickelmann et al. 2019; Fraillon et al. 2019). Based on the 2018 PIAAC survey, men perform slightly better than women in problem solving in technology-rich environment. On average across OECD countries, 32% of men score at Level 2 or 3, compared to 28% of women, although a similar share of men and women have no computer experience or have failed the ICT score test (OECD 2019).

Adult education and training can provide opportunities to develop proficiency in problem solving in tech-rich environments. Various studies have compared men's and women's participation in adult education and training in general. The results are heterogeneous. In some studies, a gender training gap was identified, i.e., women were found to participate in training less likely than men (Dieckhoff and Steiber 2011; Evertsson 2004; Pischke 2001). However, there are also empirical evidence that women participate to a similar (Albert et al. 2010; Bassanini et al. 2005) or even higher extent (Dämmrich et al. 2014; Jones et al. 2008; Simpson and Stroh 2002). The question arises whether there exists important group heterogeneity among men and women, which is crucial in determining the participation incidence. Particularly, the household context, that is the

presence of a partner and children, has been shown to significantly influence participation in training (Boll and Bublitz 2018). The gender training gap has been found to interact with the level of education (Wozny and Schneider 2014) as well as occupational and sectoral characteristics (Burgard 2012; Dostie and Javdani 2020; Wotschack 2019).

The gender training gap differs considerably between countries and several authors argue that gender differences in training participation arise due to country-specific institutional setups (Arulampalam et al. 2004; Dämmrich et al. 2015, Dieckhoff and Steiber 2011; Wozny and Schneider 2014).

There are much less studies about gender differences in participation in more specific type of adult education and training, such as ICT-related training (see for example Jannsen and Wölfel 2017). Drawing on the most recent data from the Eurostat Adult Education Survey 2016, this report aims to fill this gap, by addressing the following research questions: first, do men and women with comparative characteristics differ in participation in ICT-related training? If so, how does this gendered training participation varies between countries? Second, how household characteristic (e.g., presence of children) as well as workplace-related (occupational and sectoral) characteristics interact with the gender training gap? Third, can country-specific characteristic contribute to explaining this country variation in gendered training participation? More specifically, we focus on four institutional characteristics: relative power of women in labour force, family policies, gender culture and overall gender inequality index.

2. Theoretical perspectives

2.1 The gender training gap

The gender training gap has been explained by human capital theory, 'doing gender' theories and discrimination theories. Human capital theory is concerned with the incentives for employers to invest in education and training (Becker 1975). It is expected that returns on training relative to its costs are most central in the skill investment decisions of both workers and employers. To explain differences between men and women in training participation, human capital theory refers to the variations in the labour force participation over the life course (Blau and Ferber 1992). Three differences between men and women have been argued to produce a gender training gap. First, as mothers spend considerable time outside the labour market, they are confronted with shorter time for recovering training investments. Second, in times of rapid technological change, women who return to the labour market after a prolonged period of leave face the problem of skill depreciation. This could reduce the incentive for women to train if they plan to have children in the near future, as they cannot be sure that this training will produce any return after a career break. Third, Becker (1985) argues that married women dedicate more time to household activities than married men. Investments in human capital that is of value in the labour market should be less attractive for women as they can reap lower returns.

Theories of 'doing gender' postulate that gender roles are structured by practiced behaviour in the household context (West and Zimmerman 1987). During family building, the traditional gender roles are revitalized (Dieckhoff and Steiber 2011). From a gender role perspective, it is actual presence of care responsibilities that is the central mechanism affecting women's training participation.

Discrimination theories stress the perspective of employers. Taste-based discrimination against women implies a lower level of pay at which employers are willing to hire women (Becker 1957). One way to reduce pay is reducing training cost for women. Women may receive less training because of statistical discrimination (Arrow 1973; Phelps 1972). Employers perceive gender as a predictor of productivity. If women are predicted to be less productive, employers will invest less in training for women. Due to traditional division of work within couples, employers might perceive mothers as less committed to their jobs than women without children with similar characteristics. By contrast, fathers are assumed to be more attached to their work career than otherwise similar men (Correll et al. 2007). Employer discrimination against women might particularly evolve in the case of parenthood.

2.2 Gender segregation

According to a variant of human capital theory, women, because they anticipate career interruptions, choose occupations that require skills with low depreciation rates (Polachek 1981). Lower requirements for further training in female-dominated occupations would explain the gender training gap. Gender role theories predict that women choose occupations that require lower level of skill investments (Schwartz 1992). Employers' discriminatory practices in hiring might also prevent women from access to positions that are associated with greater opportunities for continuing training (Pfeffer and Ross 1990; Tomaskovic-Devey and Skaggs 2002). If women have no access to men's jobs, they do not have such training opportunities that relate to these jobs.

These approaches emphasize the importance of the type of job for training participation over and above of worker characteristics. If once selected into certain occupations, the amount of training is shaped firstly by skill requirements of the job and not so much by workers' skills and incentive structures.

Previous studies indicate that training participation is higher in some occupations and sectors (Asplund 2005). The literature of occupational segregation suggests that the proportion of male workers in an occupation is positively related to the employment rewards (including training opportunities) that workers obtain, while a high proportion of women in an occupation is associated with lower levels of rewards (Reskin and Bielby 2005). However, some studies indicate that the demand for additional training is higher in education, health and social work sectors where many jobs are based on state-provided educational tracks and where women dominate (Estevez-Abe 2005). Wotschack (2019) argues that for female-dominated sectors and occupations higher rates of female training participation are often resulted from a stronger need for training and more legal regulations. Sectors and occupation related to ICT activities tend to be

male-dominated. However, previous research in Germany have not shown significant gender differences in training participation in information and communication (Wotschack 2019).

According to model developed by Sap (1993) the proportion of women in the bargaining unit affects their bargaining power and could make women more capable of bargaining or competing for better training opportunities. Therefore, over-presentation of women in a sector or occupation could create specific conditions that could result in better training opportunities for women compared to men. A model of discrimination and segregation also assume that female-dominated industries or occupations might engage less in discriminatory behaviour of employers, while women in male-dominated industries and occupations might have to compete harder for training opportunities (Altonji and Blank 1999). On contrary Grönlund (2012) supposes that female-dominated occupations display a lower level of on-the-job training requirements than occupations dominated by men. Employers' deliberations on training investments may relegate women occupations with lower training requirements. Her empirical analysis even provides some support for the hypothesis that on-the-job training is a mechanism of gender segregation.

2.3 Institutional context

Comparative studies on training participation have confirmed the importance of country-specific institutions in explaining gender differences in training participation (Dämmrich et al. 2016; Dieckhoff and Steiber 2011; Wozny and Schneider 2014). Institutions may also moderate the effect of individual characteristics on training participation. We focus on three country characteristics which have been found to have impact on gender differences in training participation: the relative power of women in the labour market, family policies and the gender culture.

Previous analysis confirms the importance of relative power of women in the labour market for female training participation (Wotschack 2019). When the work force and/or the management are composed of higher share of women, career and training interests of women should receive more attention and more power to be realized.

Family policies encouraging women's continuous participation in the labour market have been shown to positively affect women's and especially mothers' rate of labour market participation and also participation in training (Dieckhoff and Steiber 2011). In countries with more generous childcare facilities and shorter parental leave, females' labour market participation is higher (An 2013). In turn, higher labour market participation is linked to higher training participation (Estevez-Abe et al. 2001). Childcare tends to reduce the gender differences, as it enables women to return to the labour market. In contrast, longer parental leaves can have negative effects on women's training participation because these measures tend to keep mothers out of the labour market for longer (Estevez-Abe 2005).

Country-specific beliefs and norms about women's and men's roles in society and in the labour market may also have an impact on gender differences in training participation. Employers'

discrimination against women has been found to be lower in more gender-egalitarian countries (Triventi 2013). In these societies men and women are also more equal in terms of labour market participation. Previous results indicate that employers in more gender-egalitarian societies are also less likely to discriminate women related to training participation than in societies with more traditional gender cultures (Dämmrich et al. 2015). Dostie and Javdani (2020) also explain women privileges to participate in training in non-profit sector by their over-presentation in this sector.

3. Data and methods

The analysis is based on the European Union Adult Education Survey (AES) 2016. This survey is part of the EU statistics on lifelong learning (formal, non-formal and informal) and is carried out every five years. AES 2016 is the latest wave available, conducted in 2016 and 2017 with the sample representative of 25- to 64-year-olds living in private households. In this report, data on 29 European countries is analysed (N = 187,884).

Participation in training related to information and communication technologies is defined by the field of the 1st and/or 2nd non-formal education and training activity twelve months prior to the interview. Hence, the analysis distinguishes between adults who have participated in ICT training either in their 1st or 2nd (or both) educational activity and those who have participated in training related to other fields or have not participated in any training. The AES 2016 questionnaire does not specify further the content of the ICT training, which could have been either in the form of courses, workshops and seminars, guided-on-the-job training or private lessons. Mainly, respondents have participated in ICT training in the form of courses and guided-on-the-job training.[1]

The impact of independent variables is studied at micro-, meso-, and macro-level, i.e., at individual, workplace, and country level respectively. At the micro-level following characteristics are included: gender, age group (25–39, 40–49, 50–64), and educational level (ISCED 0–2, ISCED 3–4, ISCED 5–8). Additionally, from household composition analysis includes marital status (living or not living in a consensual union) and having children in the household (0–13 years old). From workplace-related characteristics analysis controls for occupation, firm size and sector (economic activity of the local unit). We distinguish four occupational groups: high-skilled white-collars (ISCO 1–3), low-skilled white-collars (ISCO 4–5), 'high-skilled blue-collars (ISCO 6–7) and low-skilled blue-collars (ISCO 8–9). Categories for firm size are following: 1–10 persons, 11–19, 20–49, 50 or more and no answer but 10 or more persons. Lastly, we distinguish between three economic sectors based on NACE classification: construction, mining, manufacturing,

[1] According to AES 2016 pooled country data, the distribution of types of the 1st non-formal learning activity in the field of ICT is as follows: courses 40%, workshops and seminars 21%, guided-on-the-job training 37.5% and private lessons 1.7%.

transportation etc. (A-F, H), sale, retail, accommodation, catering (G, I, T), professional, scientific, technical activities, administration and services, etc. (J-S, U).

To explore the impact of macro- or country-level characteristics on gender differences in participation in ICT courses, analysis includes aggregate data from various other sources:

Relative power: the share of female employees in the work force (Eurostat), the share of female in management (OECD)[2];

Gender culture: disagreement or strong disagreement with the statement that *when job's are scarce, men should have more right to a job than women* (World Values Survey (WVS));

Family policies: the share of children in childcare below the age of 3 years and between 3 and schooling age (Eurostat), the length of paid maternity and parental leave (OECD);

Gender Inequality Index (UNDP)[3], GII measures gender inequalities in three aspects of human development: (i) reproductive health, measured by maternal mortality ratio and adolescent birth rates; (ii) empowerment, measured by proportion of parliamentary seats occupied by females and proportion of adult females and males aged 25 years and older with at least some secondary education; and (iii) economic status, expressed as labour market participation and measured by labour force participation rate of female and male populations aged 15 years and older.

Macro-level characteristics from OECD and WVS have missing data in case of some countries (maximum 5 countries out of 29), thus the number of countries included in the analysis at this stage varies. Description of macro-level characteristics is provided in Appendix (Table 1a–4a).

To analyse micro-level determinants of participation in ICT-related training, binary logistic regression is used. Further, regression models control for interactions with gender by household and job-related variables to determine if the impact of these characteristics on ICT training varies for men and women. The effect of macro-level characteristics on participation in ICT training is analysed by applying multilevel logistic regression and controlling for individual-level characteristics. Additionally, to investigate possible modifying effect of macro-level variables on gender differences in participation in ICT courses interactions with gender are introduced (interactions are included step-by-step in separate models).

[2] Additionally, at the macro-level we controlled for the effect of the share of female engineers and scientists (Eurostat measure). However, this effect was in an unexpected direction, i.e., higher share of female engineers and scientists is associated with lower female ICT training participation. As this measure does not provide additional explanation to the gendered ICT training participation, we exclude it from the final analysis.

[3] For more details on the UNDP GII see http://hdr.undp.org/en/content/gender-inequality-index-gii

4. Results

According to the Adult Education Survey 2016, in EU-28 on average 37% or men and 34% of women participated in non-formal education and training (NFE). Focusing specifically on NFE courses in the field on ICT, it appears that in countries studied here, in the whole AES sample 5.4% of men and 4.6% of women report taking part in such training activities[4]. Therefore, overall men are somewhat more often participating in NFE and also in ICT-related NFE. However, there are considerable country variations. Results in Figure 1 indicate that for women participation rate in ICT courses is the highest, about 6% to 11%, in Norway, Spain, Germany, France, Austria, Belgium, Sweden and the Netherlands. While at the other extreme, in Greece, Lithuania, Hungary, Poland and Romania ICT courses participation rate among women is only 2% or less.

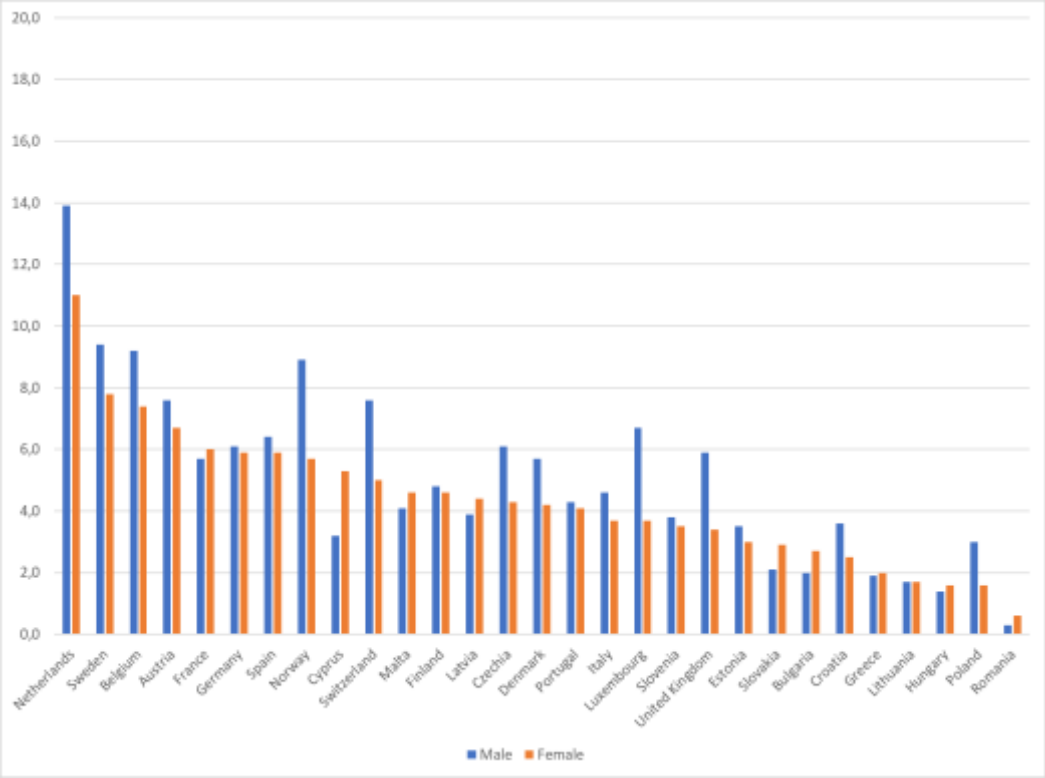

Figure 1. Participation in ICT courses by gender: ICT training in the whole sample (vs other trainings and not participating in any NFE) [ordered by female participation rate]

Source: AES 2016

[4] If the sub-sample of those adults who have participated in NFE, 12.6% of men and 10.7% of women report that the field of their studies was related to ICT (excluding those who have not participated in any kind of NFE activity).

Additionally, it appears that among highly scoring countries, men tend to participate in the ICT courses more often than women, but gender differences seem smaller in countries with lowest levels of participation (apart from Poland).

Gender differences in taking up ICT courses are presented in further detail in Figure 2. Disadvantage of women is most pronounced in Norway, Luxembourg, the Netherlands, Switzerland and the United Kingdom, where men report participating in ICT related courses 3.2 to 2.5 percentage points more compared to women. Somewhat smaller difference in favour of men (around 2 to 1.5 percentage points) is apparent in the Czech Republic, Belgium, Sweden, Denmark and Poland. While only in Cyprus women are noticeably more often (2.1 percentage points) reporting ICT related training activities. Gender difference is in favour of women also in Slovakia, Bulgaria, Latvia, Malta and Romania, but in these countries difference in participation rates is less than 1 percentage point. Thus overall, in 17 countries out of 29, gender difference in ICT training participation is below 1 percentage point.

Country differences in gendered ICT training participation should depend on the content of training (whether it is targeted to improve customer service or database structure and programming, etc) and skills level (see also Jannsen and Wölfel 2017). However, AES does not provide such additional information.

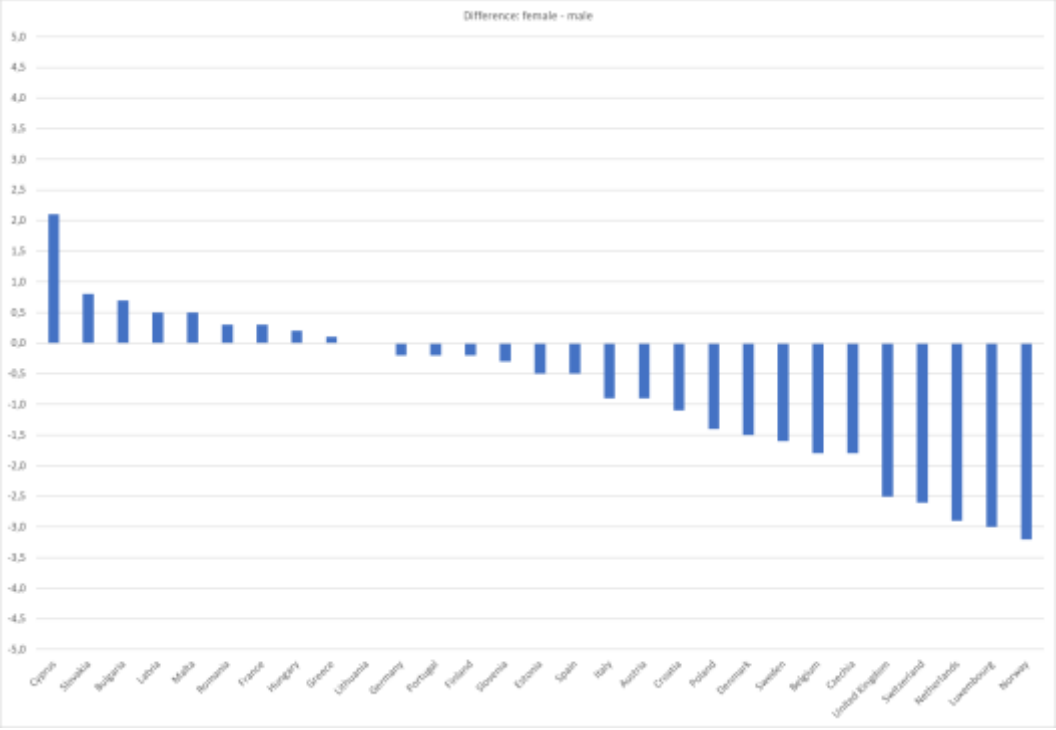

Figure 2. Gender difference in participation in ICT courses: female participation – male participation

4.1 The effect of individual and workplace-related characteristics on participation in ICT training

Logistic regression results in Table 1 (p 13) indicate the impact of individual and workplace-related characteristics on participation in ICT courses. It appears that women compared to men have lower probability to participate in ICT courses (Model 1), this disadvantage increases after additional individual, occupational and sectoral characteristics are considered (Model 2–4). Differences in ICT courses participation by age group are significant when the model controls for individual characteristics (Model 2). Accordingly, 40–49-year-olds have higher probability and 50–64-year-olds lower probability to take up ICT-related courses than the youngest age group – 25-39-year-olds. However, age effect is not significant after adding workplace-related characteristics to the analysis. Expectedly, there are considerable differences according to highest completed education, as those with medium (ISCED 3–4) and particularly those with higher (ISCED 5–8) education participate in ICT training more compared to persons with lower educational attainment (ISCED 0–2).

From the household composition variables, having 0–13-years-old children tends to be associated with higher participation in ICT courses. However, when the model controls for occupation and other workplace-related characteristics (Model 3), having young children is not significantly associated with ICT training participation. The analysis would be more revealing and informative if data would differentiate between for instance 0–4-year-old children, but the AES 2016 does not provide such distinction.

All workplace-related characteristics included in the analysis have significant impact on the probability to participate in ICT training. According to occupational position, compared to high-skilled white-collars other groups have lower probability to take part in ICT courses (Model 3). Firm size appears to have considerable impact on the ICT training probability. Hence, participation in ICT courses increases with the firm size. Regarding economic sector or industry, results imply that compared to construction, mining, manufacturing and transportation participation in ICT-related training tends to be higher in the professional, scientific, technical activities, administration and services. In contrast, ICT training participation tends to be lower in retail, accommodation and catering sectors.

Table 2 (p 14) presents interaction effects between gender and household and job-related characteristics. Results show that the impact of household characteristics on participation in ICT courses does not differ by gender. However, gender and job-related characteristics interactions are statistically significant. According to occupational group, women have considerably lower probability to participate in ICT courses compared to men in high-skilled white-collar positions (see Figure 3, p 15). Yet among low-skilled white-collars women have the advantage in participating in ICT training. In the group of low-skilled white-collars, on average women are overrepresented, thus it seems that participation in ICT-related courses is more prevalent among women in female-dominated occupations. Among blue-collar occupations gender differences in ICT training participation are less pronounced.

Interaction terms with firm size reveal that women have significantly lower probability to participate in ICT courses in larger firms (50 persons or more) (Figure 4). Thus, ICT training participation is more equal between genders in smaller firms, particularly those employing 1–10 persons (see also Wotschack 2019: 464).

Table 1. Participation in ICT-related courses: the effect of individual and job characteristics (odds ratios, standard error in parentheses)

	Model 1	Model 2	Model 3
Gender *(ref male)*			
female	0.87 (0.02) ***	0.82 (0.02) ***	0.75 (0.03) ***
Age *(ref 25–39)*			
40–49		1.10 (0.03) ***	1.04 (0.03)
50–64		0.88 (0.03) ***	0.99 (0.03)
Education *(ref low)*			
medium		2.50 (0.05) ***	1.38 (0.06) ***
high		6.10 (0.05) ***	1.61 (0.05) ***
Marital status *(ref living in a cons. union)*			
not living in a cons. union		1.03 (0.03)	1.03 (0.03)
Having 0–13 years old children *(ref no)*			
yes		1.06 (0.03) *	1.05 (0.03)
Occupation *(ref high-skilled white-collar)*			
low-skilled white-collar			0.74 (0.03) ***
high-skilled blue-collar			0.20 (0.07) ***
low-skilled blue-collar			0.15 (0.07) ***
Firm size *(ref 1–10 persons)*			
11–19			1.23 (0.05) ***
20–49			1.41 (0.05) ***
50+			1.82 (0.04) ***
no answer, but 10+			1.75 (0.07) ***
Sector *(ref construction, mining, manufacturing, transportation etc)*			
sale, retail, accommodation, catering			0.83 (0.05) ***
professional, scientific, technical activities, admin and services, etc			1.32 (0.03) ***
Intercept	0.05 (0.02) ***	0.01 (0.02) ***	0.05 (0.02) ***
N	205 382	194 696	110 442
BIC	70315.38	64212.31	46072.05
Pseudo R-squared	0.00	0.05	0.09

Note: * p <0.05 ** p <0.01 *** p <0.001

Table 2. Participation in ICT-related courses: interaction effects with gender by household and job characteristics (odds ratios, standard error in parentheses)

	Model 1	Model 2	Model 3	Model 4	Model 5
Gender *(ref male)*					
female	0.74 (0.03) ***	0.77 (0.03) ***	0.62 (0.03) ***	0.88 (0.07)	1.08 (0.06)
Age *(ref 25–39)*					
40–49	1.04 (0.03)	1.04 (0.03)	1.04 (0.03)	1.04 (0.03)	1.04 (0.03)
50–64	0.98 (0.03)	0.98 (0.03) ***	0.98 (0.03)	0.99 (0.03)	0.99 (0.03)

Education *(ref low)*					
medium	1.38 (0.06) ***	1.38 (0.06) ***	1.38 (0.06) ***	1.38 (0.06) ***	1.38 (0.06) ***
high	1.61 (0.05) ***	1.61 (0.05) ***	1.61 (0.05) ***	1.61 (0.05) ***	1.60 (0.05) ***
Marital status *(ref living in a cons. union)*					
not living in a cons. union	1.03 (0.04)	1.05 (0.03)	1.05 (0.03)	1.04 (0.03)	1.04 (0.03)
Having 0–13 years old children *(ref no)*					
yes	1.05 (0.03)	1.10 (0.03) *	1.05 (0.03)	1.05 (0.03)	1.05 (0.03)
Occupation *(ref high-skilled white-collar)*					
low-skilled w-c	0.74 (0.03) ***	0.74 (0.03) ***	0.47 (0.06) ***	0.74 (0.04) ***	0.73 (0.04) ***
high-skilled b-c	0.20 (0.07) ***	0.20 (0.07) ***	0.18 (0.08) ***	0.20 (0.07) ***	0.21 (0.07) ***
low-skilled b-c	0.15 (0.07) ***	0.15 (0.07) ***	0.13 (0.09) ***	0.15 (0.07) ***	0.15 (0.07) ***
Firm size *(ref 1–10 persons)*					
11–19	1.23 (0.05) ***	1.23 (0.05) ***	1.24 (0.05) ***	1.33 (0.08) ***	1.24 (0.05) ***
20–49	1.41 (0.05) ***	1.41 (0.05) ***	1.44 (0.05) ***	1.48 (0.07) ***	1.42 (0.05) ***
50+	1.82 (0.04) ***	1.82 (0.04) ***	1.85 (0.04) ***	2.06 (0.06) ***	1.82 (0.04) ***
no answer, 10+	1.75 (0.07) ***	1.75 (0.07) ***	1.80 (0.07) ***	1.97 (0.10) ***	1.76 (0.07) ***
Sector *(ref construction, mining, manufacturing, transportation etc)*					
sale, retail, accommo., catering	0.83 (0.05) ***	0.82 (0.05) ***	0.83 (0.05) ***	0.83 (0.05) ***	0.94 (0.07) ***
professional, scientific, technical activities, admin and services, etc	1.32 (0.03) ***	1.32 (0.03) ***	1.32 (0.03) ***	1.32 (0.03) ***	1.32 (0.03) ***
Gender*Marital Status					
female*not living in a cons. union	1.03 (0.06)				
Gender*Children					
female*having 0–13 y o children		0.91 (0.05)			
Gender*Occupation					
female*low-skilled w-c			2.12 (0.07) ***		
female*high-skilled b-c			1.48 (0.18) *		
female*low-skilled b-c			1.54 (0.14) **		
Gender*Firm size					
female*11–19				0.86 (0.10)	
female*20–49				0.90 (0.09)	
female*50+				0.79 (0.08) **	
female* no answer, 10+				0.80 (0.14)	
Gender*Sector					
female* sale, retail, accommo., catering					0.68 (0.10) ***
female* professional, scientific, technical act. etc					0.62 (0.07) ***
Intercept	0.04 (0.08) ***	0.04 (0.08) ***	0.04 (0.08) ***	0.04 (0.08) ***	0.04 (0.08) ***
N	110 442	110 442	110 442	110 442	110 442
BIC	46083.35	46080.88	45972.31	46106.55	46044.98
Pseudo R-squared	0.09	0.09	0.09	0.09	0.09

Note: * p <0.05 ** p <0.01 *** p <0.001

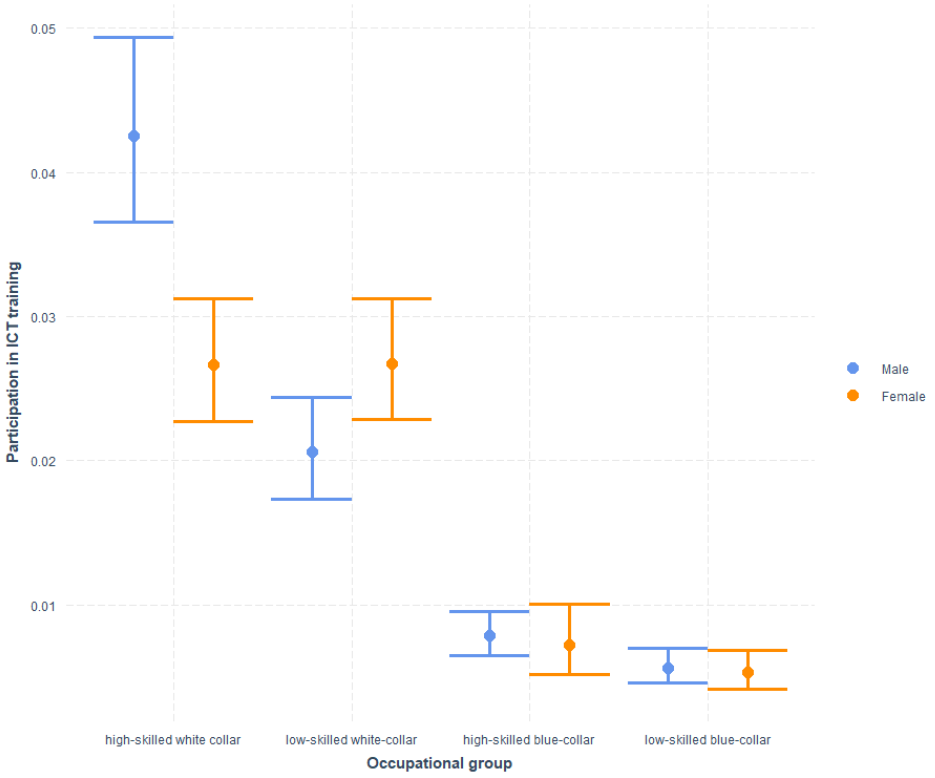

Figure 3. Participation in ICT courses: interaction between gender and occupational group

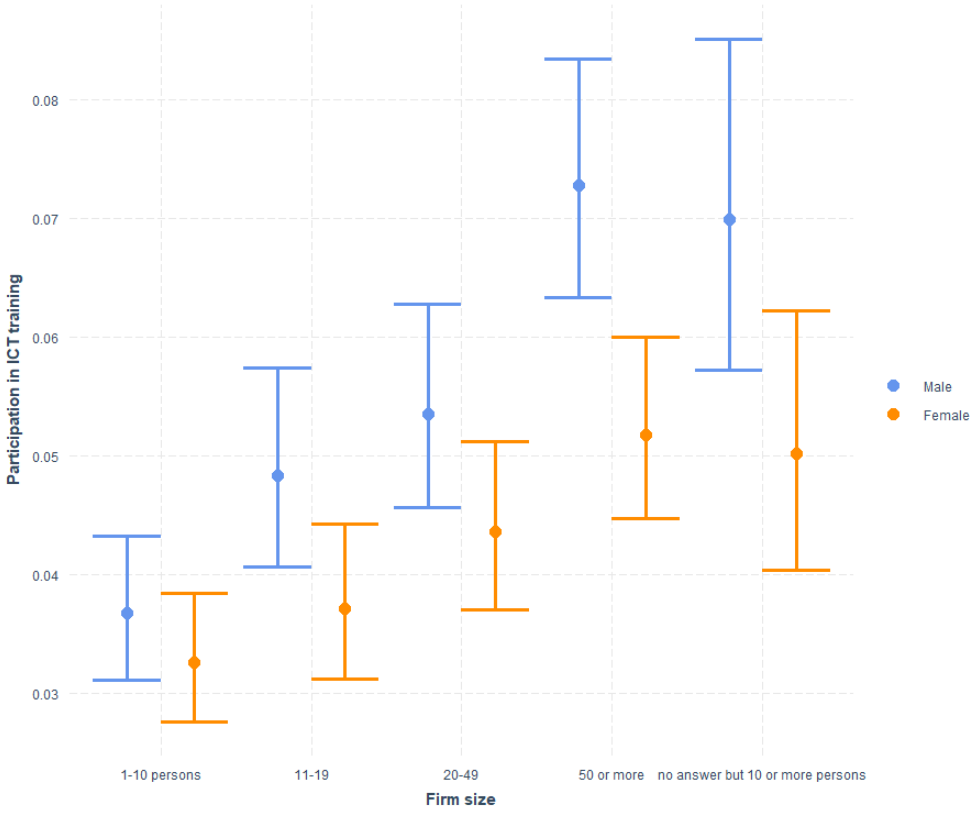

Figure 4. Participation in ICT courses: interaction between gender and firm size

Economic sector also has different impact on ICT participation probability depending on gender (Figure 5). Hence, women are most disadvantaged compared to men in ICT training participation in the sectors of professional, scientific and technical activities, and administration and services, but also in retail, accommodation and catering. While participation in ICT courses is rather equal in construction, mining, manufacturing and transportation – sectors dominated by male employees.

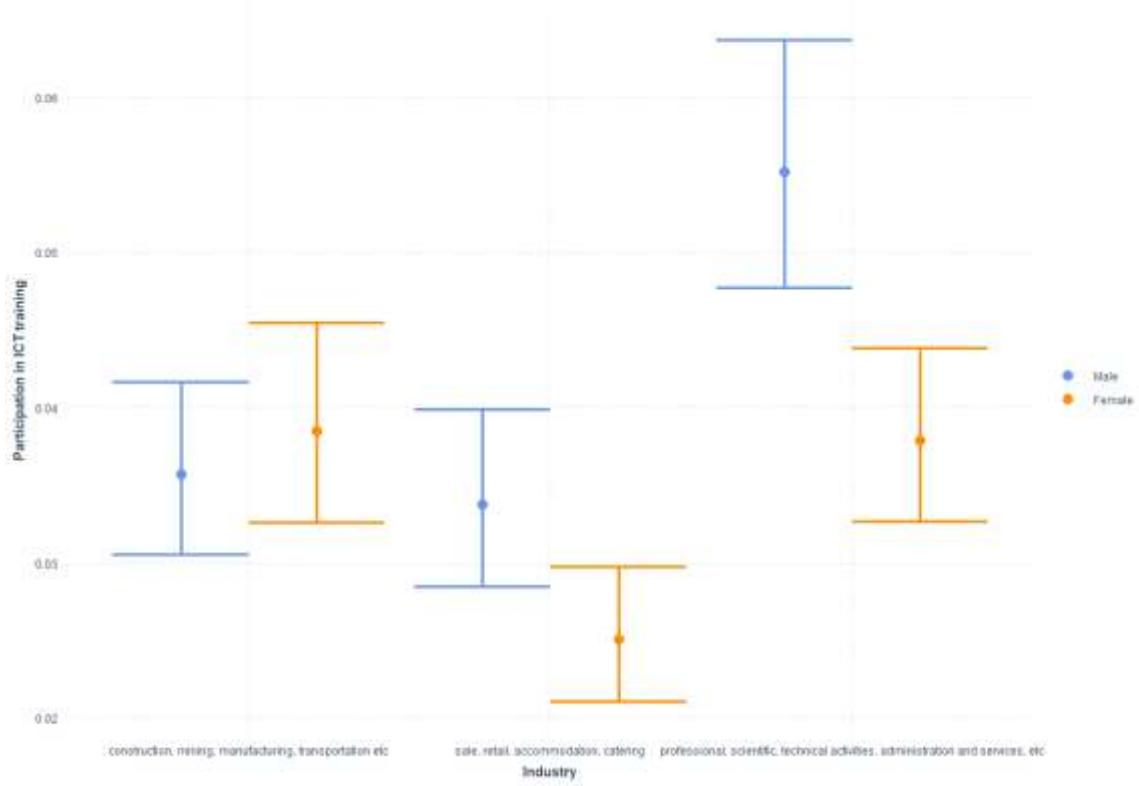

Figure 5. Participation in ICT courses: interaction between gender and economic sector

4.2 The modifying effect of macro-level characteristics on gender differences in participation in ICT training

Multilevel regression results (presented in Appendix, Table 6A) explore the modifying effect of macro-, i.e., country-level characteristics on gender differences in participation in ICT training (for results without interaction terms see Appendix, Table 5a). It appears that interaction terms with gender are significant in case of the share of female workers in the workforce, the share of women among managers, i.e., the relative power of women on the labour market[5], gender culture

[5] At the macro-level we also controlled for the effect of the share of female engineers and scientists. This resulted in a negative effect, i.e., higher share of female engineers and scientists is associated with lower female ICT training participation (similar to the effect of the share of female managers). We assume that this result might

and overall gender inequality index (in case of GII $p<0.1$). While the effect of provision of formal childcare and length of maternity-parental leave on ICT course participation do not differ by gender. However, examining confidence intervals, results show that interactions between gender and macro-level characteristics are clearer in case of gender culture and GII (see Appendix, Figure 1a and 2a for cross-level interactions by the share of female workers and managers by gender).

According to Figure 6, more egalitarian gender culture (disagreement with the statement that when jobs are scarce, men should have more right to a job than women) tends to increase overall participation in ICT training, but the effect is stronger for men. So contrary to expectations, more equalitarian beliefs and norms regarding gender relations in a country, does not mitigate gender inequality in ICT courses participation. Additionally, Figure 7 shows that in countries with lower GII value, i.e., countries with fewer inequalities between females and males regarding health, empowerment and economic status, participation in ICT training is higher, but again, the effect is stronger for men.

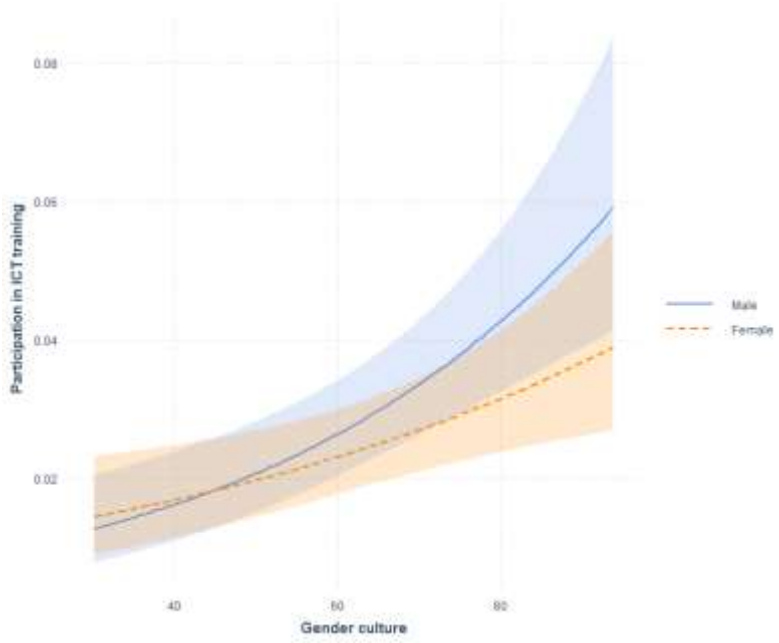

Figure 6. Cross-level interaction effect: participation in ICT training by gender culture and gender.

reflect the fact that AES data is capturing mainly rather basic ICT courses, while more complex training could be taking place on-the-job or via independent learning (including private lessons or informal learning).

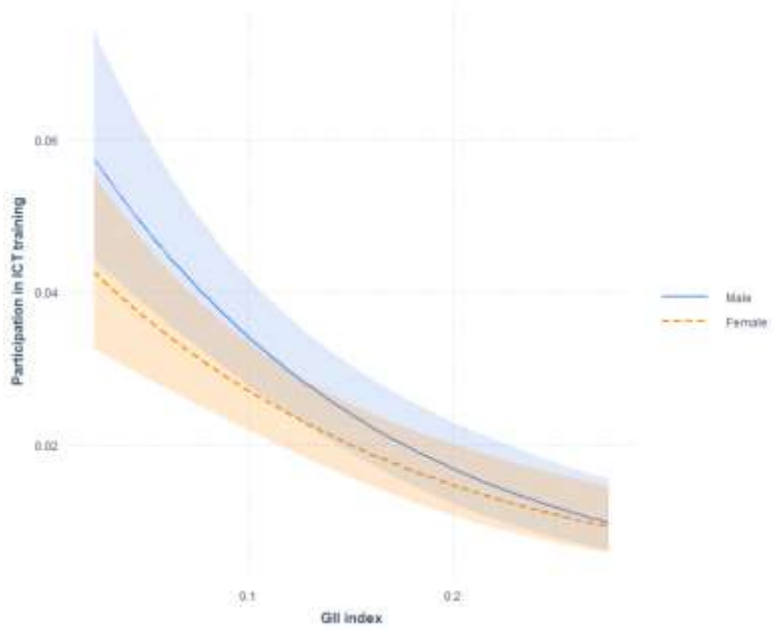

Figure 7. Cross-level interaction effect: participation in ICT training by the Gender Inequality Index and gender

5. Conclusions

The report aimed to explore gender differences in participation in ICT training. Despite previous surveys commonly finding that men use computers somewhat more frequently than women do as well as some disadvantage for women in ICT literacy so far surprisingly little research has been conducted on gender gap in ICT training. This study used the most recent data from the Adult Education Survey (2016) in order to investigate the effects of household characteristics as well as occupational and sectoral/industry characteristics on female ICT training participation and the gender training gap. Special attention is paid on country variation in gendered training participation and the contribution of country-specific institutional characteristics in this variation.

Following predominant theories in the field of gender training gap, it was assumed that employers tend to ascribe lower returns to training to female workers since women face a higher risk of career interruptions. Women are also often not willing to participate in training since they can reap lower and more risky returns to training. Our analysis revealed that women are somewhat disadvantaged in ICT training participation. However, these mentioned theories neglect the importance of macro-level institutional and meso-level, i.e., workplace-related differences.

Gender segregation and gender role theories emphasize the importance of the type of job for training participation over and above of worker characteristics. Our analysis indicated that

gender difference varies more between jobs than between household context showing that occupational and sectoral gender segregation has a mediating effect on the gender training gap. However, a considerable gap in ICT training participation was found also between men and women working in the same occupation and in the same sector.

The analysis clearly confirmed that gender differences in ICT training participation differ between sectors and occupational groups. Organizations in sectors of professional, scientific and technical activities as well as in retail, accommodation and catering have higher gender ICT training gap. The training participation is rather equal in construction, mining, manufacturing and transportation. These results contradict previous findings about general gender training gap indicating that this gap is lower in female-dominated sectors and higher in male-dominated sectors. We explain this contradiction with content of training (whether it is targeted to improve customer service or database structure and programming, etc) in different sectors. Analysis presented by Jannsen and Wölfel (2017) in Germany indicate that female disadvantage is the biggest in trainings connected with advanced ICT training and especially in programming but women have even advantages in task oriented training targeted to improve customer services. Unfortunately, we were not able to study gender gap by different types of ICT training. Disadvantage of women working in high-skilled white-collar occupations could also be explained by content of training.

Usually, it is assumed that large firms are more likely to have institutionalized human resource policies and/or a formal personnel office. They have more administrative resources and face a stronger need to invent formalized regulations in order to manage their larger work force. However, our results indicate that smaller firms show better outcomes. Regarding (equal) ICT training participation, it seems to be more advantageous for women to work is smaller firms. The analysis presented by Wotschak (2019) in Germany indicate also that gender training gap is smaller in small firms. He explained this result by the fact that solidarity, fairness norms and social control are more important in smaller work settings.

Regarding household composition, the expectations were that women with children are less likely to train. This prediction was, however not confirmed by our analysis. Children up to 13 years of age in household do not show negative effect on women's ICT training participation. Analysis would be more revealing and informative if we could differentiate between for instance 0–4-year-old children, but the AES 2016 does not provide such distinction.

One of our aims was to investigate potential cross-country differences with regard to gendered ICT training participation. In line with previous research, we found evidence for cross-country variation in the level of ICT training participation and training gender gap. It appears that women have highest ICT participation rate in Norway, Spain, Germany, France, Austria, Belgium, Sweden and the Netherlands. Countries representing different institutional context, for instance in terms of welfare regime. Moreover, results indicate that gender gap in ICT training courses in favour of men tends to be higher in countries with rather high overall ICT participation rates, such as Norway, Luxembourg, the Netherlands, Switzerland and the United Kingdom. Evidence for differences between countries in terms of training predictors is less obvious. However, it seems

that gender culture and overall gender inequality measured by the UNDP index – GII comprising health, empowerment and economic status indicators – tend to modify gendered ICT training gap. Namely, in countries characterised by more egalitarian gender culture, participation in ICT training is higher, but this effect is stronger for men, so participation gap is relatively high. Similarly, participation in ICT courses is higher in countries with lower GII, i.e., lower level of gender inequalities in different spheres of life, but again the effect is stronger for men. Stoet and Geary (2018) suggest that in less gender-equal countries women are more likely to engage in the fields of science, technology, engineering and mathematics to find a way out of difficult living conditions. Accordingly, in such countries girls might feel the pressure to use new technologies and acquire ICT competencies and thus this could explain why in more gender egalitarian countries gendered ICT training gap is higher.

These findings are important both for our understanding of gender differences in ICT training participation as well as policy making in the fields of ICT training and gender equality. Our results indicate that there could be some role for supporting workplace female-friendly policies geared towards women with more training (see also Huffman et al. 2017; Wotschack 2019). Some previous studies conclude that gender occupational and sectoral segregation is very important predictor of gender training gap. However, our analysis indicates that ICT training gap is not lower but even bigger in female-dominated occupations and sectors. This result seems to suggest that paying attention to women's labour market opportunities should not be limited to their access to certain workplaces, occupations and sectors. In order to further improve females' opportunities for ICT training participation, policies that could continue to support women within workplaces are required.

Recent studies seem to indicate lessened gender gap in participation in computer-related professions (Lau and Yuen 2015). Also, the disadvantage of girls in terms of computer attitudes has become less self-evident. However, as mentioned in introduction there are big gender differences in expectations about working in ICT-related occupations among youngsters. Social environment (family, school etc.) is reproducing the traditional stereotypes about perceived masculinity of computers. Studies also indicate that girls feel less confident about their computers competencies and tend to underestimate their abilities, while boys tend to overestimate their achievements (Meelissen 2008). Teachers seem to have a role in this confidence gap. Therefore, initiatives to lessen gender-based stereotypes about ICT-related activities could increase girls' interest in programming and other computer applications and might help reduce differences in participation in ICT training.

Future research should pay more attention to the distribution of male and female employees to sectors and occupations with different ICT training requirements as well as the content of training. The data used in this study do not provide information on differences in terms of content of the ICT courses nor on returns to training. As other studies have shown, these differences provide another possible source of gender inequality (Green et al. 2016; Jannsen and Wölfel 2017) and should be addressed in future research. Additionally, employers' calculations on training investments and social closure processes in the workplace deserve further attention.

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Appendix

Table 1a. Relative power: Employment rate [LFSI_EMP_A__custom_539576], Eurostat; The share of female in management, OECD.

	Female employment rate	Female managers
Belgium	68.1	32.2
Bulgaria	68.8	Na
Czechia	79.0	25.3
Denmark	77.2	27.7
Germany	77.3	29.1
Estonia	77.4	35.8
Greece	65.1	24.7
Spain	73.7	30.9
France	73.4	32.4
Croatia	65.3	Na
Italy	59.0	27.2
Cyprus	73.8	Na
Latvia	78.6	46.8
Lithuania	79.7	39.1
Luxembourg	69.4	17.5
Hungary	68.0	39.2
Malta	60.8	Na
Netherlands	76.2	24.9
Austria	74.8	31.5
Poland	66.3	40.6
Portugal	75.8	35.7
Romania	60.3	Na
Slovenia	73.0	40.2
Slovakia	70.1	35.1
Finland	77.7	33.9
Sweden	84.1	39.2
United Kingdom	75.2	35.7
Norway	79.4	37.7
Switzerland	81.5	35.9

Table 2a. Gender culture: World Values Survey 2017/20, When jobs are scarce, men should have more right to a job than women: disagree + disagree strongly

	Disagree and disagree strongly
Belgium	83.8
Bulgaria	48.4
Czechia	59.4
Denmark	91.3
Germany	79.5
Estonia	75.8
Greece	43.1
Spain	76.7
France	80.3
Croatia	68.4
Italy	53.1
Cyprus	38.6
Latvia	Na
Lithuania	52.0
Luxembourg	Na
Hungary	56.6
Malta	Na
Netherlands	81.2
Austria	67.5
Poland	66.8
Portugal	66.7
Romania	35.7
Slovenia	77.3
Slovakia	30.2
Finland	87.4
Sweden	93.8
United Kingdom	83.4
Norway	92.1
Switzerland	68.8

Note: for Belgium ESS data

Table 3a. Family policies: Formal childcare % less than 3 years and from 3 years up to compulsory school age, 30 hours or over per week (Eurostat, EU-SILC survey [ilc_caindformal]); Total length of paid maternity and parental leave (weeks), OECD 2016

	Formal childcare < 3 years	**Formal childcare > 3 up to compulsory shool age**	**Lenght of paid maternary, parental leave**
Belgium	28.5	73.3	32
Bulgaria	12.5	67.3	Na
Czechia	1.7	55.2	110
Denmark	62.2	84.3	50
Germany	21.4	53.2	58
Estonia	20.8	84.1	166
Greece	6.0	40.5	43
Spain	18.7	43.9	16
France	31.9	56.9	42
Croatia	13.5	46.9	Na
Italy	22.3	74.3	47.7
Cyprus	18.0	37.8	Na
Latvia	26.6	80.3	94
Lithuania	12.5	70.8	62
Luxembourg	33.0	55.4	42
Hungary	12.2	73.1	160
Malta	13.2	56.6	Na
Netherlands	5.4	19.5	16
Austria	5.6	23.7	60
Poland	5.6	45.7	52
Portugal	47.2	86.2	30.1
Romania	8.8	10.1	Na
Slovenia	35.7	81.4	52.1
Slovakia	0.5	65.0	164
Finland	22.9	60.2	161
Sweden	33.6	69.6	55,7
United Kingdom	4.4	27.2	39
Norway	47.0	78.3	91
Switzerland	5.9	13.0	14

Table 4a. Gender Inequality Index: the higher the GII value the more disparities between females and males and the more loss to human development (UNDP)

	Gender Inequality Index
Austria	0.069
Belgium	0.043
Bulgaria	0.206
Croatia	0.116
Czechia	0.136
Cyprus	0.086
Denmark	0.038
Estonia	0.086
Finland	0.047
France	0.049
Germany	0.084
Greece	0.116
Hungary	0.233
Italy	0.069
Latvia	0.176
Lithuania	0.124
Luxembourg	0.065
Malta	0.175
Netherlands	0.043
Norway	0.045
Poland	0.115
Portugal	0.075
Romania	0.276
Slovakia	0.191
Slovenia	0.063
Spain	0.070
Sweden	0.039
Switzerland	0.025
United Kingdom	0.118

Table 5a. Participation in ICT-related courses: the effect of macro-level characteristics (odds ratios, standard error in parentheses)

	Model 1	Model 2	Model 3	Model 4	Model 5
Gender *(ref male)*					
female	0.75 (0.03) ***	0.78 (0.03) ***	0.77 (0.03) ***	0.75 (0.03) ***	0.77 (0.03) ***
Age *(ref 25–39)*					
40–49	1.01 (0.03)	1.01 (0.03)	1.02 (0.03)	1.01 (0.03)	1.02 (0.03)
50–64	0.92 (0.04) *	0.93 (0.04) *	0.92 (0.04) *	0.92 (0.04) *	0.92 (0.04) *
Education *(ref low)*					
medium	1.78 (0.07) ***	1.78 (0.07) ***	1.74 (0.06) ***	1.78 (0.07) ***	1.74 (0.06) ***
high	2.05 (0.07) ***	2.07 (0.07) ***	2.01 (0.07) ***	2.05 (0.07) ***	2.01 (0.07) ***
Marital status *(ref living in a cons. union)*					
not living in a cons. union	0.96 (0.03)	0.98 (0.03)	0.97 (0.03)	0.96 (0.03)	0.97 (0.03)
Having 0–13 years old children *(ref no)*					
yes	0.95 (0.03)	0.96 (0.03)	0.96 (0.03)	0.95 (0.03)	0.96 (0.03)
Occupation *(ref high-skilled white-collar)*					
low-skilled w-c	0.75 (0.04) ***	0.75 (0.04) ***	0.75 (0.04) ***	0.75 (0.04) ***	0.75 (0.04) ***
high-skilled b-c	0.24 (0.08) ***	0.21 (0.08) ***	0.23 (0.08) ***	0.24 (0.08) ***	0.23 (0.08) ***
low-skilled b-c	0.18 (0.08) ***	0.17 (0.08) ***	0.17 (0.08) ***	0.18 (0.08) ***	0.17 (0.08) ***
Firm size *(ref 1–10 persons)*					
11–19	1.21 (0.05) ***	1.25 (0.05) ***	1.23 (0.05) ***	1.21 (0.05) ***	1.23 (0.05) ***
20–49	1.38 (0.05) ***	1.40 (0.05) ***	1.42 (0.05) ***	1.38 (0.05) ***	1.42 (0.05) ***
50+	1.78 (0.04) ***	1.81 (0.04) ***	1.81 (0.04) ***	1.78 (0.04) ***	1.80 (0.04) ***
no answer, 10+	1.44 (0.08) ***	1.40 (0.08) ***	1.38 (0.08) ***	1.44 (0.08) ***	1.39 (0.08) ***
Sector *(ref construction, mining, manufacturing, transportation etc)*					
sale, retail, accommo., catering	0.81 (0.05) ***	0.82 (0.05) ***	0.81 (0.05) ***	0.81 (0.05) ***	0.81 (0.05) ***
professional, scientific, technical activities, admin and services, etc	1.18 (0.04) ***	1.19 (0.04) ***	1.20 (0.04) ***	1.18 (0.04) ***	1.20 (0.04) ***
Share of F in workforce	1.04 (0.02) *				
Share of F managers	0.96 (0.01) **				
Gender culture		1.02 (0.01) ***			
Childcare < 3 years			1.01 (0.01)		
Childcare from 3 years			0.99 (0.01)		
Parental leave weeks				1.00 (0.00) *	
GII index					0.00 (1.16) ***
Intercept	0.01 (1.16) ***	0.01 (0.39) ***	0.04 (0.30) ***	0.05 (0.18) ***	0.07 (0.16) ***
N	88 830	95 830	103 081	88 830	103 081
N country	24	26	29	24	29
BIC	40317.98	40179.56	43319.38	40309.31	43287.84

R-squared (fixed)	0.21	0.23	0.20	0.20	0.25
R-squared (total)	0.25	0.28	0.26	0.24	0.28

Note: * p <0.05 ** p <0.01 *** p <0.001

Table 6A. Participation in ICT-related courses: interaction effects with gender by macro-level characteristics (odds ratios, standard error in parentheses)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Gender *(ref male)*							
female	2.03 (0.34) *	1.21 (0.16)	1.49 (0.15) ***	0.81 (0.05) ***	0.83 (0.05) ***	0.76 (0.05) ***	0.71 (0.05) ***
Age *(ref 25–39)*							
40–49	1.02 (0.03)	1.02 (0.03)	1.01 (0.03)	1.02 (0.03)	1.02 (0.03)	1.01 (0.03)	1.02 (0.03)
50–64	0.92 (0.04) *	0.92 (0.04) *	0.93 (0.04) *	0.92 (0.04) *	0.92 (0.04) *	0.92 (0.04) *	0.91 (0.04) *
Education *(ref low)*							
medium	1.73 (0.06) ***	1.77 (0.07) ***	1.78 (0.07) ***	1.74 (0.06) ***	1.74 (0.06) ***	1.78 (0.07) ***	1.74 (0.06) ***
high	2.00 (0.07) ***	2.05 (0.07) ***	2.07 (0.07) ***	2.07 (0.07) ***	2.01 (0.07) ***	2.05 (0.07) ***	2.01 (0.07) ***
Marital status *(ref living in a cons. union)*							
not living in a cons. union	0.97 (0.03)	0.96 (0.03)	0.98 (0.03)	0.97 (0.03)	0.97 (0.03)	0.96 (0.03)	0.97 (0.03)
Having 0–13 years old children *(ref no)*							
yes	0.96 (0.03)	0.96 (0.03)	0.96 (0.03)	0.96 (0.03)	0.96 (0.03)	0.95 (0.03)	0.96 (0.03)
Occupation *(ref high-skilled white-collar)*							
low-skilled w-c	0.75 (0.04) ***	0.75 (0.04) ***	0.75 (0.04) ***	0.75 (0.04) ***	0.75 (0.04) ***	0.75 (0.04) ***	0.75 (0.04) ***
high-skilled b-c	0.23 (0.08) ***	0.24 (0.08) ***	0.22 (0.08) ***	0.23 (0.08) ***	0.23 (0.08) ***	0.24 (0.08) ***	0.23 (0.08) ***
low-skilled b-c	0.17 (0.08) ***	0.18 (0.08) ***	0.17 (0.08) ***	0.17 (0.08) ***	0.17 (0.08) ***	0.18 (0.08) ***	0.17 (0.08) ***
Firm size *(ref 1–10 persons)*							
11–19	1.23 (0.05) ***	1.21 (0.05) ***	1.25 (0.05) ***	1.23 (0.05) ***	1.23 (0.05) ***	1.21 (0.05) ***	1.23 (0.05) ***
20–49	1.42 (0.05) ***	1.39 (0.05) ***	1.41 (0.05) ***	1.42 (0.05) ***	1.42 (0.05) ***	1.38 (0.05) ***	1.42 (0.05) ***
50+	1.81 (0.04) ***	1.79 (0.04) ***	1.81 (0.04) ***	1.81 (0.04) ***	1.81 (0.04) ***	1.78 (0.04) ***	1.80 (0.04) ***
no answer, 10+	1.38 (0.08) ***	1.44 (0.08) ***	1.41 (0.08) ***	1.38 (0.08) ***	1.38 (0.08) ***	1.44 (0.08) ***	1.39 (0.08) ***
Sector *(ref construction, mining, manufacturing, transportation etc)*							
sale, retail, accommo., catering	0.81 (0.05) ***	0.82 (0.05) ***	0.82 (0.05) ***	0.81 (0.05) ***	0.81 (0.05) ***	0.81 (0.05) ***	0.81 (0.05) ***
professional, scientific, technical activities, admin and services, etc	1.20 (0.04) ***	1.18 (0.04) ***	1.19 (0.04) ***	1.20 (0.04) ***	1.20 (0.04) ***	1.18 (0.04) ***	1.20 (0.04) ***
Share of F in workforce	1.04 (0.02) **						
Female*Share of F in WF	0.99 (0.00) **						
Share of F managers		0.98 (0.02)					
Female*Share of F mngrs		0.99 (0.00) **					
Gender culture			1.03 (0.01) ***				

Female*Gender culture			0.99 (0.00) ***				
Childcare < 3 years				1.01 (0.01)			
Female*Childcare < 3 years				1.00 (0.00)			
Childcare from 3 years					1.00 (0.00)		
Female*Childcare from 3 y					1.00 (0.00)		
Parental leave weeks						1.00 (0.00) *	
Female*Parental leave wks						1.00 (0.00)	
GII index							0.00 (1.20) ***
Fender*GII index							2.78 (0.56)
Intercept	0.00 (1.15) ***	0.08 (0.52) ***	0.01 (0.40) ***	0.03 (0.19) ***	0.03 (0.31) ***	0.05 (0.19) ***	0.07 (0.16) ***
N	103 081	88 830	95 830	103 081	103 081	88 830	103 081
N country	29	24	26	29	29	24	29
BIC	43308.44	40312.34	40171.85	43318.91	43320.87	40320.69	43296.06
R-squared (fixed)	0.21	0.19	0.23	0.19	0.19	0.20	0.25
R-squared (total)	0.27	0.24	0.28	0.26	0.26	0.24	0.28

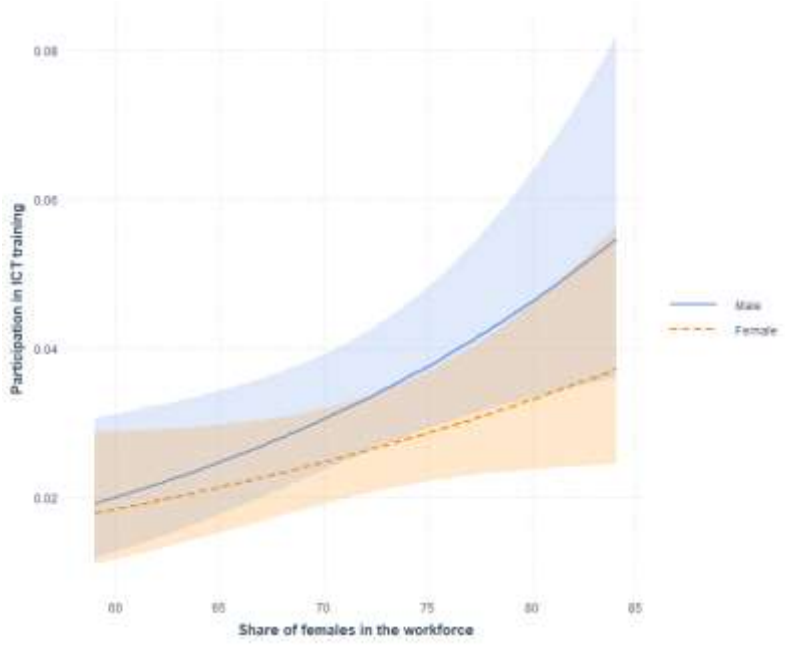

Figure 1a. Cross-level interaction effect: participation in ICT training by the share of females in the workforce and gender

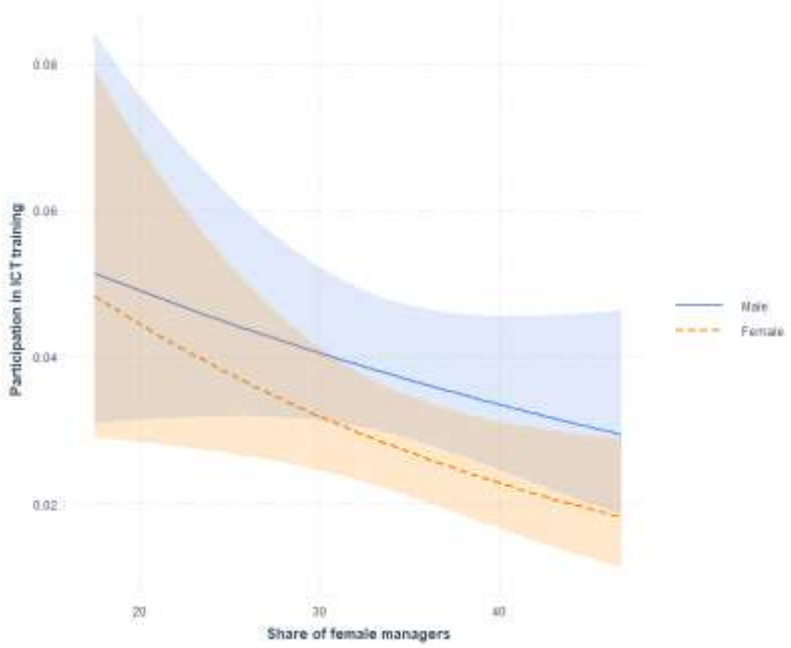

Figure 2a. Cross-level interaction effect: participation in ICT training by the share of females among managers and gender