WHY DON'T WOMEN CHOOSE STEM? GENDER EQUALITY IN STEM CAREERS IN LATVIA

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Abstract: The study represents a contribution to the work which examines gender equality in the Science, Technology, Engineering, Mathematics (STEM) sphere in EU and in Latvia in particular and gives the recommendations on how to change gender quality situation among researchers and professionals in STEM. The research was conducted based on a questionnaire survey aimed at developing an understanding of women's experiences of STEM career pathways in Latvia.

Key words: gender equality, STEM, industry, science, interview, analysis

1. INTRODUCTION

Gender equality and mainstreaming in research are among the key priorities of Horizon 2020 [1] and includes in a set of the Sustainable Development Goals: "Providing women and girls with equal access to education, health care, decent work, and representation in political and economic decision-making processes will fuel sustainable economies and benefit societies and humanity at large" [2].

The US Department of Labour estimates that from 2010-2020 there will be approx. 1.4 million computing-related job openings available in the US, but at current college graduation rates in computing, only 32% of jobs can be filled by US computing graduates [3]. The situation is the same in Europe and more women entering in Science, Technology, Engineering, and Mathematics (STEM) education could expand the employee pool.

The literature about gender inequality in STEM has uncovered the presence of a 'leaky pipeline' [4], meaning that women systematically drop out of the STEM track at various points along the education and their career ladder. For instance, in the US, about as many girls as boys leave high school prepared to pursue STEM careers, but only 20% of STEM degrees are earned by females [5].

To understand women's experiences in the workplace, the metaphor 'glass ceiling' is used to describe the blocked career advancement of women [6]. This is quantified by the Glass Ceiling Index (gender equity in science) [7].

As a key factor in women's attrition all along the STEM pipeline many authors perceive – a lack of women role models. There is evidence for the importance of adequate and sustained mentoring of women students by other women [8].

The goal of the paper is to analyse the situation of female involvement in STEM industry and research in Latvia and the barriers faced by women. The structure of the paper is as follows. Section 2 presents statistics about women in STEM in the EU and Latvia. In section 3, methods of qualitative analysis of the situation are presented based on face-to-face interviews. The results are presented and discussed in sections 4 and 5. Section 6 includes the conclusion and next steps.

2. POSITION OF WOMEN IN STEM IN EU AND LATVIA

The European Commission takes the view that without gender equality in science and a better use of the human resources available scientific excellence will never be truly achieved within the European Research Area [9]. Three main pillars in order to address the gaps [10] in female participation in science are considered:

- barriers to the recruitment, retention and career progression;
- gender imbalances in decision making processes;
- the gender dimension in research programmes.

There are significant differences in stereotyping, working conditions, and the labour market that affect women's participation in higher education (HE) and research [11]. The Global Gender Gap Report presents the magnitude of gender-based disparities and tracks their progress over time [12]. The methodology of the Gender Index measuring was developed in 2006; information and data were collected by the World Economic Forum. Based on the report from 2016 [12] Latvia has a good position in total rank – 18 out of 144 countries and continues to make progress on closing their gender gaps, with improvements particularly in female representation in politics, among legislators, senior officials and managers. Slovenia, Latvia and Estonia, the top-ranked countries in the Eastern Europe and Central Asia, have closed 79%, 75% and 75% of their overall gender gaps, respectively [12]. Out of the 26 countries in the region, only Latvia has fully closed gaps in Educational Attainment and Health and Survival. Latvia is among the three countries with the highest percentage of female research and development personnel.

In 2010, on average throughout the EU-27, 15.5% of institutions in the HE Sector were headed by women, and 10% of Universities had a female rector. On average, 36% of board members were women in 2010 [13]. But in Latvia in 2016 eight out of 30 (27%) HE establishments had a female rector or acting rector.

Unfortunately, that statistics hide differences across STEM fields. Building gender equality is of particular importance in STEM where the female representation remains low [14]. As noted in [15], women are more likely to have a higher education degree but remain under-represented in STEM and related careers. The proportion of women among researchers in STEM management did

not change between 2001 and 2016 despite major increases in the percentage of women among students and total number of researchers. In 2015, the proportion of women was 38% among PhD students and 10% among full professors [13]. A similar pattern could be observed in the Information and Communication Technologies (ICT) labour market: almost 8 million of ICT specialists in the EU in 2015 of which 16% (1.2 million) were women [16].

Across the EU, none of the states demonstrated more than 27.7% of women employed in ICT; women accounted for less than 12% of ICT specialists in the Czech Republic, Slovakia and Hungary, while one ICT specialist out of 4 was a woman in Bulgaria, Romania and Latvia. In Latvia in 2015, ICT specialists consist of 14.6 thousand men and 4.8 thousands women [16].

About 1.4 million people were studying ICT in the EU in 2015 and only 17% of all ICT students were women. Across the EU member states, their share ranged from less than 10% in Netherlands (6%) and Luxembourg (8%) to over 30% in Bulgaria (34%) and Belgium (33%) (Fig.1). Latvia has 18% female ICT students.

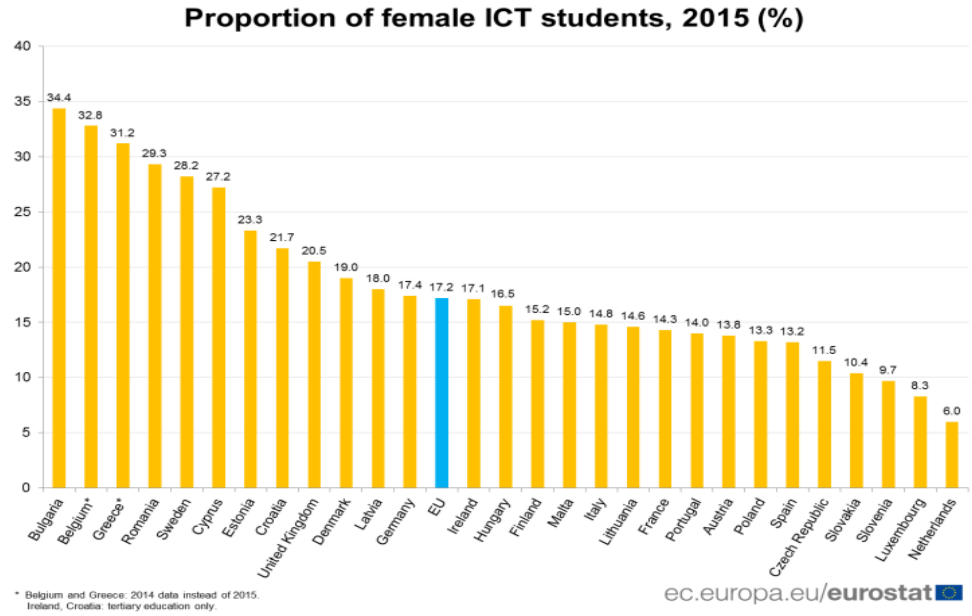

Fig. 1. Proportion in % of female ICT students in EU, 2015 (Eurostat)

Transport and Telecommunication Institute (TTI) (www.tsi.lv) is the only private Latvian university of applied science with emphasis on STEM education. TTI has approximately one thousand students in its ICT Faculty and its graduates make up 15% of the total number of ICT graduates in Latvia. Analysing the gender distribution in the faculty showed that women were largely in a minority: 13% of

undergraduates, 27% of masters students. The situation with staff is better (36%), but only 38% of them have a PhD.

And even when women manage to get a STEM degree, they are less likely to work in that field [13]. According to the latest US census, only 1 in 7 women with a degree in STEM actually works in that area. And this is true for most countries.

3. METHOD. INTERVIEW: WOMEN IN STEM

Qualitative research was used to achieve a deep understanding of one particular issue. The research was based on an extended face-to-face questionnaire survey retrieving the knowledge about situation with female under-representation in the STEM field in Latvia.

The survey involved female professionals in the STEM sector and the questionnaire contained variables which required both qualitative and quantitative responses. Quantitative questions sought to understand the respondents' positions in terms of academic and professional qualifications, positions they occupy, marital status, age. On the part of the qualitative variables, the questions sought to establish their views on factors contributing to, or inhibiting their participation in the STEM sector, their experiences related to patriarchal attitudes and beliefs within the society; the work environment and gender relations in the work place; etc.

The questionnaire was based partly on a survey provided by UNESCO [17]. It was designed for completion by both academic and non-academic staff and consisted of 5 parts. All individual survey responses were kept confidential and used for research purposes only. Participants were contacted via e-mail and after a brief introduction they were invited for individual face-to-face in-depth interview.

Part A included 4 questions about socioeconomic information: respondent category: academia-research/industry/public sector and position occupied, age, education level and marital status.

Part B included the question "Are women under-represented in engineering in Latvia":

- in classes or in academic/research staff of the university, where you studied;
- at your current workplace.

The respondents should specify their level of agreement or disagreement on a symmetric Likert scale (1-5): from "1- Not at all" to 5 – "Extremely".

Social science theories of inequality in the workplace contribute to understanding women's disparate experiences in organizational cultures that are gendered [18]. The next questions (Part C) ask the respondent to indicate their level of agreement ("1 - Strongly Disagree" to "5 - Strongly Agree") with the statements listed below:

- negative traditional beliefs that women are inferiors to men are contributing to girls'/women's lack of enthusiasm for education in STEM;

- the majority of girls prefer to study softer sciences (management, philology etc.);
- lack of motivation from parents - one of the factors resulting in the under-representation of women in engineering;
- fear of hard subjects (mathematics, physics) - one of the factors resulting in the under-representation of women in engineering;
- working conditions in industry are more suitable for men than women;
- a gender difference that is greater at higher levels of an income than at lower levels of an income;
- men in STEM industry and research have more opportunities than women;
- is it true that females are a burden to organization due their family and reproductive role?

Group of questions in Part D ask the respondent to indicate the main gender related blocks to women's progress in STEM careers (from "1 - Strongly Disagree" to "5 - Strongly Agree"): male dominance oriented attitudes by the management in STEM; women's lack of confidence and assertiveness in STEM; stereotyping of female roles; reproductive roles and sexual harassment.

The remaining open questions (Part E) sought to obtain qualitative responses regarding aspects of perceived gender discrimination during university studies or in their current position, and lack of institutional and disciplinary support in the current workplace. In the case of a positive answer, participants were asked further to give an example. Respondents were also asked for their personal views on how the participation of women in the STEM industry could be improved.

Using in-depth interviews allowed the interviewers the opportunity to explore differences in answers across ages. Open-ended questions were designed to capture the nuances of women's subjective experiences in their careers.

4. RESULTS

The survey focused on STEM graduate respondents. Its objective was to develop a broader understanding of women's experiences of STEM career paths. A total of 12 participants were interviewed face-to-face and their profiles are presented in Table 1. Participants consisted of junior and senior researchers in HE entities, project leaders/or system analysts in industry and managers in the public sector. Participants' ages were between 25 and 65 years. The position 'Junior' in the group 'Academy/Research' means no more than 5 years after PhD and the position 'Senior' means 'Professor' and older in age. If a 'Senior' at the same time holds an administrative position (head of department or research unit), this is noted as 'Senior/Manager'. Regarding the respondents' education level, 7 of them hold a PhD; 5 - a master diploma. The majority (75%) are married.

It must be taken into account that the numbers of respondents are low for an analysis of results to be statistically valid. However, it seems to be useful to review those statements where there is a substantial difference in response or the most

often responses (mode). The accumulated results of interviews for Part C and Part D are presented in Table 2 and Table 3 accordingly. The mode of values is highlighted in bold.

Table 1. Participants' profiles

N	***Age***	***Respondent Category***	***Position occupied***	***Completed studies***	***Status***
1	30-40	Academia/Research	Junior	PhD	Married
2	<30	Public Sector	-	Ms	Single
3	40-50	Industry	System Analyst	Ms	Married
4	>60	Academia/Research	Senior/Manager	PhD	Married
5	30-40	Industry	System Analyst	PhD	Married
6	40-50	Academia/Research	Senior	PhD	Married
7	<30	Industry	Manager	Ms	Single
8	30-40	Academia/Research	Junior/Manager	PhD	Married
9	30-40	Public Sector	Team Leader	Ms	Married
10	50-60	Academia/Research	Senior/Manager	PhD	Married
11	40-50	Industry	System Analytics	PhD	Single
12	<30	Industry	Manager	Ms	Single

Table 2. Answers for Questions from Part C

N	***Questions***	***Score***				
	(from "1 - Strongly Disagree" to "5 - Strongly Agree")	***1***	***2***	***3***	***4***	***5***
6.1	Negative traditional beliefs that women are inferiors to men are contributing to girls'/women's lack of enthusiasm for education in STEM	2	0	3	**6**	1
6.2	The majority of girls prefer to study arts or softer sciences	0	2	**5**	3	2
6.3	Lack of motivation from parents - one of the factors in the under- representation of women in engineering	2	1	**5**	4	0
6.4.	Fear of hard subjects (mathematics, physics) - one of the factors in the under-representation of women in engineering	0	4	0	**7**	1
6.5	Working conditions in STEM are more suitable for men	2	**4**	2	3	1
6.6	A gender difference that is greater at higher levels of an income than at lower levels of an income	1	1	**5**	3	2
6.7	Men in the STEM industry have more opportunities than women	2	**4**	1	3	2
6.8	Men in STEM research have more opportunities than women	2	**7**	0	2	1
6.9	Is it true that females are a burden to an organization due to their family and reproductive role?	0	1	2	3	**6**

Analysing the about feelings the female under-representation in engineering in Latvia (Part B), most of the respondents had neutral responses about gender inequality in classes, but felt it in current working places.

75% of the respondents agree or strongly agree that females are a burden to an organization due to their family and reproductive role, but at the same time 75% do not agree that men in STEM research have more opportunities than women.

More than 50% of the respondents agree that negative traditional beliefs that women are inferiors to men are contributing to girls' lack of enthusiasm for education in STEM and more than 65% agree or strongly agree that there is a fear of hard subjects, one of the factors in the under-representation of women in engineering. It is interesting to note that all respondents (5) from the 'older' group indicated a gender difference in income on high positions.

The main gender-related blocks to women's career progress in science can be ranked on the basis of 'strongly agree' or 'agree' (Table 3): 1) 'Reproductive role needs'; 2) 'Stereotyping of female roles'; 3) 'Male dominance oriented attitudes by management in STEM'; 4) 'Women's lack of confidence and assertiveness in STEM'. One respondent disclosed painful experiences of sexual harassment, but some were 'angry' about this question. This was mainly an exception and it can be concluded that past problems have almost disappeared from STEM society of Latvia. 75% do not agree that there is 'sexual harassment – gender-related block'.

Table 3. Answers for Questions from Part D

N	Indicate the main gender-related blocks to women's career progress in science (from 'Not at all' to 'Extremely')	***Score***				
		1	***2***	***3***	***4***	***5***
7.1	Male dominance oriented attitudes by the management in STEM	2	1	2	**5**	2
7.2	Women's lack of confidence and assertiveness in STEM	1	2	3	**6**	0
7.3	Stereotyping of female roles	2	0	3	2	**5**
7.4.	Reproductive role needs	0	0	4	4	4
7.5	Sexual harassment	**8**	1	2	1	0

Some interesting comments about the nuances of women's subjective experiences in their careers were recognised in the open-ended questions.

It is interesting that younger respondents feel there are no gender differences in Latvia: *'if you are talented, motivated and smart, then it does not matter what gender you are'.*

Only 2 respondents mentioned that they felt there was gender discrimination in their current position. One (from industry) remarked that some departments looks like an 'old boys' club' and higher management often make sexist remarks about female capabilities and roles in the company. *'I think the main issue with the image of women in industry lies in the view of female values, tendencies and thus capabilities. Management believes that women will always have other priorities, and women think they will have to sacrifice everything else to build a career'.*

There are many comments from academic/research staff. One mentioned that she '*will not take higher position than senior researcher of the division … if you want to make it as a female researcher you have to be much better than the men*'. Another had experience in the IT industry before an academic career and mentioned that she '*constantly felt slight gender discrimination being IT Manager in a large company in Latvia for many years. For promotion to this position, I had to work twice as much as any man alongside me. Every one of my proposals and/or ideas … was perceived as doubtful, questionable and debatable*'.

Respondents from academia suggest that it is the reason why women usually take the extra burden of administrative tasks in male-dominated sectors and, as a result, women have less time for their own research.

5. FINDINGS AND EXPLORATIONS

The survey was also able to capture views from the respondents on how to address the root causes of factors inhibiting the effective participation of women in the STEM industry and research. Most of the views provided indicated stereotypes and a lack of marketing as the main factors preventing an increasing the number of young females taking STEM subjects.

'I guess the main problem is stereotypes about women's intelligence. So any improvement in this area should be done in parenting processes'.

Another respondent suggests *'more women's community events and meetings such as "Girls in IT", more public discussions about the growing importance of increasing diversity across the IT workforce'.*

'Fostering kids' motivation to study mathematics and explaining the necessity and attractiveness of STEM can only happen gradually, step by step. We should try to change society's thinking and beliefs, convincing women that Maths and 'hard' sciences are modern, state-of-the art, and it is the best choice anyone can make to devote oneself to scientific studies. This way hopefully we can engender in our youth a deeper engagement in the 'hard' sciences and women will naturally be a part of this'.

'… major step in improving the situation would be demystifying the STEM industry – it must be presented not as something suited only for the most dedicated and competitive few, but as any other job that requires hard work during working hours, but off the clock supports families as an ultimate target audience of any progress in the STEM areas'.

'Give an understanding to the girls (in schools), that they are expected in the STEM sphere and that they can reach great heights in IT'.

Moreover, analysing the drop out statistics in TTI it seems that HE is not a significant point in the 'pipeline' in Latvia, drop-outs are happening amongst women before reaching the undergraduate level. And more attention can be paid to how young women should be motivated to make STEM careers. They usually have

little idea of what STEM professions offer, a lack of visibility of STEM options and that's why reject a STEM career before reaching the undergraduate level.

6. CONCLUSION AND FUTURE CONSIDERATIONS

In the paper, statistics on presence of women in STEM industry in Latvia were analysed. The findings cannot be generalized, but the results are useful in one particular context. Despite rising demand for STEM specialists, women, who represent over half the population in Latvia, are still underrepresented in this field and looking at student enrolment in STEM programmes, a relatively low proportion is female.

The part focusing on discrimination in interview indicates that it is the problems of the past and today we need to analyse other limitations deterring women's participation in STEM. While survey results show that, in general, women report being satisfied with their careers in STEM, they also face challenges entering the STEM workplace and especially in HE. The representative from the '*Senior researchers'* group felt the patriarchal culture of their faculty/department. University and research institutions needs to make STEM careers more female friendly and addressing today's causes of under-representation requires focusing on changes in policy and educational methods.

But more 'painful' point in pipeline is a rejection of STEM career before reaching the undergraduate level. The task is to promote STEM careers to encourage young women to perceive it as beneficial, as in their teenage years, they tend to underestimate the potential for a successful career in STEM. Future research should explore these issues, specifically undergraduate students' views on 'why don't women choose STEM'. The other future research is to complement this qualitative study with a survey of what their male colleagues think about this situation and are they conscious of these problems.

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