Gender segregation in STEM education and careers in Russia

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ABSTRACT: Until recently little intention had been paid in Russia to the topic of gender segregation in areas of STEM (science, technology, engineering and mathematics). However, the subject has been discussed widely in Europe and in other parts of the world. The aim of this article was to reveal the present state of gender segregation in Russia, to present data to compare with the European Union and to propose a solution for gender equality based on developing a good command of English. A survey carried out for this research involved students from a technical university and professionals from an industrial enterprise, so as to elicit information from all levels of STEM in Russia. The results suggest that a combination of technical expertise and English language skills provide a good base for education, career development and the empowerment of women.

Keywords: Gender segregation, STEM, higher education, employment, English language skills

INTRODUCTION

Areas of STEM (science, technology, engineering and mathematics) are crucial for technological advances and innovation, as these drive forward the economic growth of countries. To compete in today's global economy, a country needs to develop the potential of all its citizens. Nevertheless, some industries fail to attract or retain women workers, despite the increasing demand for a technologically literate workforce.

The focus of the research reported in this article was the involvement of women in STEM areas in Russia, as compared to that of EU countries. Solutions were sought for the empowerment of women, based on analysis of reasons underlying the choice of STEM areas for careers and the benefits of a good command of English.

Background

The first mention of bias against female scientists was in 1870 by suffragist and abolitionist Matilda Joslyn Gage. This phenomenon, called the Matilda effect, has become more apparent in recent years. Canadian scientists have confirmed that male scientists are quoted more often than are female scientists.

Between 2008 and 2013, a comprehensive analysis of 679,338 engineering publications from the Web of Science database across different specialties revealed that men dominate, with 80% of total authorships on engineering. Women engineers' work received lower recognition (fewer citations). Women's contribution to science is crucial, but women are still suffering from a gender gap [1].

In 1995, the Fourth World Conference on Women adopted the Beijing Declaration and Platform for Action for Equality, Development and Peace. A lot has been done since then and many aspects of the situation have improved [2]. A report by the European Institute for Gender Equality argues that opportunities for women in the EU have been growing in recent years. According to the report, however, women make up fewer than 20% of graduates in information and communication technology (ICT) across the EU [3]. The labour market is still strongly divided by gender [4].

UNESCO has been studying the role of women in science for over 30 years. The under-representation of women in STEM translates into a loss of talent, which hinders countries from reaching maximum development potential [5].

The issue of gender segregation has received attention in Europe, the USA and Russia. There is still little statistical data on the proportion of women among STEM students, but it should be noted that a lot of research has been done into revealing difficulties men and women face in their careers [6][7]. An important topic is identifying success factors that differ for men and women.

A survey was carried out in 2010 of 140 senior managers of leading Russian and foreign companies in Russia [8]. The results show that 61% of top managers believe that women must be part of senior management. The most frequently mentioned reason for that was *team balance*. Evidence suggests that the company performs better if there are at least three women on the board of directors. On the other hand, the research revealed that 40% of employees would like to have a man as their immediate superior, and only 4% would like to report to a woman. For more than 50% of employees, gender was not important. Management who refuse to provide the opportunity for women to climb the career ladder, build the greatest external barrier to promotion.

Gender stereotypes and biased attitude are more prevalent in Russian companies than in foreign ones. Women have internal barriers that hamper professional progress. Forty-two percent of women regard family as their main priority; 40% regard professional self-realisation to be as important as family life. Twenty-seven percent of women have experienced the impact of gender stereotypes. Sometimes, women turn down promotion as they feel it would be impossible to find the right work-family balance. The respondents often share the gender stereotypes of Russia. For instance, 45% believe that a career in business is incompatible with a sound family life. Thirty-six percent think that a woman is less feminine if she devotes herself to a career; 31% regard a woman CEO as an exception rather than a rule. As a result, despite positive trends in the Russian business culture, gender stereotypes are hampering the career development of many talented specialists [8].

METHODOLOGY

This research is a synthesis of analysis of literature on gender-based issues of tertiary engineering education and the potential for employability in the mineral sector. The data were collected from two institutions, an industrial and educational one, viz. the Pikalyovo Alumina Refinery, one of the leading production amalgamations in Russia, and Saint Petersburg Mining University.

Tertiary education is essential for fostering innovation and economic development. The authors compared tertiary education pathways for female students in Russia and European Union countries (Table 1). In 2019, women accounted for more than 50% of all tertiary engineering students in the EU countries and in Russia. The share of women studying for Master's degrees was about the same among tertiary students in Russia as in the EU.

Table 1: Female students as a proportion of Bachelor's and Master's courses (UNESCO Institute for Statistics, 2019).

Countries	Bachelor (or equivalent) students (%)	Master (or equivalent) students (%)	Total
Russia	70.0	29.2	53.5
EU-28	67.2	29.3	54.0

Table 2: Participation percentage of female doctoral students (UNESCO Institute for Statistics, 2019).

Countries	Proportion of women among doctoral graduates (%)	
	2007	2019
Russia	29.2	33.9
Cyprus	68.8	60.0
Latvia	59.6	57.9
Portugal	61.2	55.0
Switzerland	37.6	44.3
France	41.8	44.5
Germany	42.5	45.2
Hungary	42.1	46.9
Netherlands	41.8	49.1
EU-28	45.9	47.9

Between 2007 and 2019, the proportion of women among doctoral graduates ranged from 40% to 60% in the majority of countries in STEM study. In Russia, as well as in some EU countries, the number of female doctoral graduates has increased. The average annual growth rate of doctoral graduates was about 2.3% for women. However, in contrast to Russia, in some EU countries such as Cyprus, Latvia and Portugal, the percentage of women decreased between 2007 and 2019. In 2019, women made up 47.9% of doctoral graduates in the EU. In two thirds of the EU the proportion of women among doctoral graduates ranged from 44% to 50%, whereas in Russia the share of women was 33.9% (Table 2).

Gender balance within doctoral education is important in determining future academic researchers and labour market participation. The proportion of women among doctoral graduates still varies in fields of education; in 2019, women doctoral graduates in the EU were over-represented in education (68%), but under-represented in engineering, manufacturing and construction (29%). There were similar outcomes within Russia (Table 3).

Table 3: Female doctoral graduates by field of study (UNESCO Institute for Statistics, 2019).

Field of study	Proportion of women graduates (%)	
	EU-28	Russia
Engineering, manufacturing and construction	29	15.1
Natural sciences, mathematics and statistics	46	25.8
Arts and humanities	54	37.4
Agriculture, forestry, fisheries and veterinary	59	35.2
Health and welfare	60	38.1
Education	68	48.7

According to the UNESCO Institute for Statistics, female researchers in Russia accounted for about 40% of the total [9]. Among European countries Russia was in mid-position (Table 4).

Table 4: Participation of female researchers (UNESCO Institute for Statistics, 2019).

Country	Female researchers
Netherlands	25.8
Czech Republic	26.8
Russia	39.6
Latvia	52.2
North Macedonia	52.3

This seems to be impressive for Russia, as compared to Western Europe and North America. One reason is the tradition of gender equality in science in the Soviet Union. However, a closer look at the roles of women is less impressive. Among university professors, the proportion of women is just 10% [10]. The rest have low-key posts, such as junior research fellows, lecturers, and so on.

In science and engineering, women in the EU countries and in Russia are still a minority (Table 5).

Table 5: Proportion of women in STEM occupations (UNESCO Institute for Statistics, 2019).

Occupation	Women (%)	
	EU-28	Russia
STEM	36.1	39.5

Based on the figures above, women have a good start at university, but making significant progress seems to be difficult and hampered by factors that will be discussed below. Women account for the greatest number at Bachelor's level, but at Master's and doctoral level the proportion falls dramatically, reaching about one-third. About 20% complete their doctoral studies in engineering, manufacturing, construction, natural sciences, mathematics and statistics, while the number is significantly higher in education (48%).

SURVEY

The analysis of statistical data showed that women make a good start at Bachelor's level, but later they fade away. The authors have carried out a survey to understand what happens at higher levels. The survey was divided into three parts. The aim of the first part was to reveal the reasons underlying the choice of STEM among females. The second part focused on factors hampering female engineers' career development. The third part dealt with benefits that a good command of English may bring.

Part 1

This part of the survey aimed at identifying factors influencing the female students' choice to enrol in STEM programmes and was conducted at Saint Petersburg Mining University in the 2017-2019 academic years. The survey was anonymous. The responses of 375 first-year female students revealed a range of internal factors linked with intrinsic motivation, such as talent, as well as external factors, e.g. friends' advice, influencing their major choice (see Table 6).

Table 6: Individual choice motivation.

Factor	Respondents (%)
Encouragement from friends	7
Strong mathematics and science self-efficacy	15
Specialised pre-university education and training	18
Parental guidance	29
Good career prospects	31

Job expectations, as well as parental pressure, had a great impact on the choice of engineering as a future profession. Just under 20% stated that they studied at either specialised schools or subject-oriented classes, where STEM subjects are studied in-depth to assist students to enter technical universities. Just 15% of female students point to personal abilities as key factors for having enrolled in engineering programmes traditionally considered *male* ones. Thus, high school achievements in the STEM subjects do not necessarily lay the ground for a future career in engineering.

Part 2

This part of the survey focused on a better understanding of gender-based issues in STEM. A questionnaire was designed to identify barriers that might hamper female engineers' career progression. Interviews were carried out with 153 female representatives working for a national amalgamation, viz. the Pikalyovo Alumina Refinery, a mining enterprise in Russia [10].

Among the respondents, 49% of employers represented commerce, 29% developers of technological products and 22% metal production. A five-point Likert scale questionnaire was adopted (Table 7).

Table 7: Factors hampering female engineers' career development.

Reason	Strongly agree (%)	Agree (%)	Neither agree nor disagree (%)	Disagree (%)	Strongly disagree (%)
Lack of professional competencies	39	31	9	18	3
Gender stereotype	38	37	7	15	3
Lack of diverse experience	27	42	15	9	7
Social isolation	19	35	6	25	15
Lack of support from relatives or friends	7	12	17	37	27

In analysing the answers, combating gender stereotypes can ameliorate and remedy conditions arising from gender segregation. Perhaps surprisingly, respondents prioritised professional qualities over encouragement from family and friends. It was apparent that developed professional competencies were important for career progress. Employers highlighted the fact that it was important to develop competencies, to excel in engineering, both academically and professionally [11][12].

Part 3

A third questionnaire was conducted to study women's experience of leadership in STEM areas, and the probability of women being promoted. It is based on a widely accepted European Commission view that

> *...improving the outcomes of education and training and investing in skills in general - and language skills in particular - are important prerequisites to achieve the EU goal of increasing growth, creating jobs, promoting employability and increasing competitiveness* [13].

Foreign language is a compulsory subject in all technical universities in Russia, but many students still regard it as irrelevant for their future careers. However, foreign languages can facilitate progress in their profession especially in the realms of the increasing mobility of students [14].

The purpose of the survey was to reveal the connection (if any) between a foreign language competence and opportunities for career development. There is evidence that being able to speak English, significantly increases the chances of employment in Europe [15]. The survey indicates whether this is true in Russia as well.

To examine employers' opinions on the relationship between foreign language competence and employability, female engineers were asked the following two open-ended questions: if foreign language skills raise the level of employees' worth and, in the case of a positive answer, what are the benefits of foreign language proficiency. Almost 79% of respondents pointed to fluency in foreign languages as a considerable career asset providing professional advantage in STEM areas. The summary of the findings related to the question about the benefits of foreign language competence for career development in STEM is given below (Table 8).

Table 8: Benefits of fluency in English.

Benefits	Respondents (%)
Opportunities for self-development	10
Evidence of a high level of education reliability	11
Writing skills within international business, e.g. CVs, cover letters, reports, briefs, as well as filling in forms	15
Intercultural communication in English	21
Better perform professional duties (e.g. access foreign information resources, manuals)	42

Foreign language proficiency, in particular English, is seen by 42% of the female engineers as an important prerequisite for promotion in STEM areas. English proficiency was seen as a means of better performing professional duties. This means that a good command of English may serve as an additional tool to develop professionally that may be an advantage to help secure and advance in a position.

CONCLUSIONS

Women in both the EU and Russia strive to obtain university qualifications [16]. However, the higher the professional level, the fewer the women. The most popular field among women-doctoral graduates is education; the least popular is STEM. Russia is not different from Europe in this regard, although the proportion of women in STEM occupations in Russia is slightly higher than in the EU.

The most popular reasons given by females for starting a STEM career at universities are good career prospects and parental guidance. These *external* motivational factors may contribute to a lack of interest and motivation, resulting in slow professional progress.

Gender stereotypes are still common in STEM areas, despite some statistical data suggesting gender equality. Most women hold lowly positions and are unlikely to reach the top. The chances of employment for women graduating from *men-dominated* fields are lower than they are for men, for a number of reasons, such as lack of awareness.

A measure to decrease gender inequality in STEM areas might be to enrich it with humanities subjects. According to the data provided here, fluency in foreign languages increases female competitiveness and provides opportunities for career growth.

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