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VARIABLES OF STEM CAREER OF WOMEN IN ROMANIA

Ella Magdalena CIUPERCĂ, Alexandru STANCIU

Department of Cyber Security and Critical Infrastructure, National Institute for R&D in Informatics- ICI Bucharest, Romania

Abstract: *Participation in the multicultural conference of TECIS 2019 in Sozopol, Bulgaria, brought to the forefront of the participants' discussions a topic at the same time important and paradoxical for the 21st century: the marginalization of women in the fields of STEM (science, technology, engineering, mathematics). To discuss the topic, an ad hoc TECIS Inclusion and Diversity Working Group was set up, with 23 researchers from over 10 countries. The details provided by the participants regarding the situation in the country of origin have entrusted the researchers that this phenomenon is a versatile and extremely complex one. And yet, the difficulties encountered by women represented a common denominator; that is why the identification of the causes that led to the perpetuation of such traditionalist conditions in fields of accelerated modernization of society became a priority. In order to achieve the main objective of the Working Group, which is to work on building community and peer support, the first necessary and important step is to understand the current status of STEM in each country. To complete this stage, in this paper, we will perform a secondary analysis of the available statistical data for Romania to identify Romanian cultural specific in the field of participation of women in STEM education and STEM labor force. Further, we will develop a series of hypotheses that will underpin future studies.*

Keywords *(max.5): STEM, marginalized group, education, labor force, inclusion*

1. INTRODUCTION

The need to accurately understand the situation of women involved in STEM in Europe was born in the multicultural environment created within the intercultural conference TECIS 2019. The networking discussions spontaneously and naturally slipped from conference topic (applications of robotics, artificial intelligence, blockchain) to related topics like quality of life of professionals, STEM career or how the gender variable influences these topics, all to illustrate the overwhelming role of the subjective dimension of human beings. An ad-hoc discussion group was enthusiastically established with the purpose of understanding the situation of the involvement of women in STEM fields in Europe (Doyle Kent *et al.*, 2020).

Of course, such an approach is necessary to be based, in a first stage, on analyzing the situation existing in each country, as this is reflected by the statistical data. In this paper, we will try to describe and analyze the Romanian socio-political context from the perspective of the involvement of women in STEM.

2. WOMEN AND DISCRIMINATION IN RECENT HISTORY

The discriminatory treatment of women over the centuries may seem at least astonishing at present. Discrimination against women who represents half of the world's population was justified by the differences between the sexes, in particular by resorting to arguments that supported women inferiority, especially as traditional society was organized having as a fundamental criterion the force, which was expressed in battles or in physical work. Beginning with the Industrial Revolution the physical effort was took over by machines, creating the premises of changing the criteria of social order. The work automation has shifted the emphasis from the physical force towards intellectual skills, creativity, social abilities and this way today labor market includes more and more jobs in the field of human resources, security and safety, entertainment, supervision of the person, creative activities, environmental protection or other types of activities where women have proven they can achieve excellence.

Over time, researches have shown that there are more similarities than differences between men and women and that differences are sometimes more pronounced within individuals of same sex than between the sexes (Richmond - Abbott, 1992, 35).

A substantial contribution to changing social mindsets was brought by the feminist movement, which accepts that gender is built on socio-biologically determined premises, but draws attention to the need to analyze all the specific variables for a person, not just those determined by sexual differences (Haraway, 1990; Gatens, 1991). Medicine and neuroscience are increasingly clarifying today this long-debated issue, complementing the social sciences in the effort to decipher their springs: gender differences in math aptitude (Emerson, McGoldrick and Mumford, 2012), sensitivity to grades (Rask and Tiefenthaler, 2008; Goldin, 2013; Kugler, Tinsley and Ukhaneva, 2017), competitiveness (Reuben, Wiswall and Zafar, 2017; Buser, Niederle and Oosterbeek, 2014; Flory, Leibbrandt and List, 2014), taste for the subject matter (Dynan and Rouse, 1997; Wiswall and Zafar, 2014) and preferences over different job attributes, which are linked to different seniors (Wiswall and Zafar, 2017).

In order to be accepted, STEM women had to become socially visible. By questioning the traditional social order, STEM women trigger a silent conflict with men whose world they claim. However, the existence of an opinion opposed to the majority arouses dissatisfaction and resistance, as it is affirmed and remains unchanged over time, individuals are accustomed to considering it as an alternative solution and treating it as such. The STEM women question the traditional social norm, differing from the majority on the basis of the gender criterion and professional orientation. According to the literature of social psychology regarding the social influence determined by the active minorities, the STEM women do not represent active minorities (Moscovici, 1979) in the true sense of the word, because they do not militate actively to impose their point of view. But this social group can be included in the category of active catalytic minorities (Ciuperca, 2004) because, through their daily professional activity, the society became aware of the need to involve them more actively in social life. Through the style of behavior characterized by consistency and trust (Maass and Clark, 1984), women working in STEM fields can manage to attract the majority's attention to them and produce a division of the social field and its specific balance.

3. THE PARADOXICAL PRESENT-DAY MARGINALIZATION OF WOMEN IN THE FIELDS OF STEM

Although women's access to traditional men's fields has been slow and cumbersome, they have managed to prevail in recent times. Still, STEM fields remain a fortress that women do not always manage to conquer. Although they show enthusiasm and idealism, a strong spirit and living intelligence, an increased ability to take risks and trust their own powers, to involve in traditionally masculine fields can prove to be a major challenge sometimes.

The acronym STEM has been proposed firstly in United States in order to unify in one concept the fields of Science, Technology, Engineering, and Mathematics. The usefulness of this concept, subsequently adopted by the whole world, has been proven in the analysis of the programs, practices, policies included in the mentioned fields. The National Science Foundation (NSF) defines STEM as the disciplines of chemistry, computer and information technology science, engineering, geosciences, life sciences, mathematical sciences, physics and astronomy, social sciences (anthropology, economics, psychology, and sociology), and STEM education and learning (Gonzalez & Kuenzi, 2012).

Within this paper, in relation to its objective, we will opt for the more restrictive meaning of this term, namely the math-intensive science fields (geosciences, engineering, economics, math, computer science, and physical science), where statistics indicate an over-representation of men.

In the literature there is a series of research regarding the sociodemographic variables of involvement of women in STEM fields. Xie and Shaumann (2003) found that married women with children rarely succeed in completing STEM studies or pursuing a full-time career in these fields, in promoting or seeking better jobs. Kahn and Ginther (2015) pointed out that the inability to work part-time is the main reason for this migration and it is highly correlated with child-bearing. Cavanaugh (2017), Ginther and Rosenbloom (2015), Orrenius and Zavodny, 2015) highlighted the tendency of women in STEM domains to migrate to nonSTEM domains.

Literature explains the law number of STEM women labor force using two models:

A. The Leaky Pipeline Model
B. Vanish Box Model

The first model, The Pipeline Model, focuses on the point women leave STEM (Blickenstaff, 2005)

and describes the linear progression of women through secondary school and higher education to careers in STEM and examines the points of "leakage" (Maltese & Tai, 2011). According to the model, there are three "leakage points" along the pipeline where women leave STEM fields (Blickenstaff, 2005): 1. initial matriculation into a higher education institution; 2. when a student who was originally interested in a STEM field chooses a non-STEM major; 3. a STEM graduate chooses a career in a non-STEM field.

The second model, The Vanish Box Model considers the absence of female scientists employed in academia as a result of their transition to science-related professions. In this approach the perspective is based on the hypothesis that women in STEM are leaving academia because of blockages they do not find in the business sector (Etzkowitz & Ranga, 2011). Obstacles includ academic format, gendered labor separation, women in the outer circle, gender bias in funding, fear of being perceived as leeving carrers or highly assertive and confrontational (Etzkowitz, & Ranga, 2011). Finnally women may leave STEM career but they still use their skills in connected sectors.

On the occasion of the celebration of 203 years from the birth of the world's first programmer Ada Lovelace, the European Commission has launched the *Women in Digital* Report. The results underline some gender gaps for all considered indicators, with minor exceptions depending on the country. For example, in Latvia, Slovenia, Bulgaria, Lithuania and Cyprus, women score higher on digital skills than men.

In digital jobs there are 9.3% of people with tertiary studies, of which 14.8% men and 4.1% women, and the gap is widening as in 2011 there were 13.5% of men and 3.4% of women. Also the number of ICT women is reducing with 16,1% in 2015 while there were 22,2% in 2005.

In European Union, women leave STEM more than men. Confirming the previous researches, women tend to leave STEM area when they are in their prime working age, having their first child and/or having to take care of their small children: while around 1.2% of those male digital workers with tertiary education left their profession in 2015 and the number of women leaving carrier number is 8.7% for the same year.

The percent of men working in the digital sector is 3.1 times greater than the share of women and the gender gap is more preeminent considering the working population with tertiary studies is considered.

While it is widely considered that an ICT major offers bigger employment chances, this may be true only for men. Probably, stereotypes are more powerful than the skills and certificates women may have.

4. THE CURRENT STATUS OF ROMANIAN STEM WOMEN

In Romania, the evolution of social life was really challenging: the forced industrialization specific to the communist period did not allow a real change of the traditionalist relations between the sexes, while the emancipation of the woman was generally equated with its inclusion on the labor market.

Despite this egalitarian ideology that dominated the Romanian ideological landscape for half a century, the evolution of mentalities has registered in recent history a rather marginal progress in the field of gender equality and statistics continue to highlight a number of gender inequalities and discrimination.

Since 2016, the Istanbul Convention, signed in June 2014, has been applied in Romania, being the first international treaty containing a definition of gender, respectively, recognizing that women and men are not only biologically differentiated, but also socially defined as gender category that gives women and men specific roles and behaviors. The main objectives of this legislative text include the prevention of violence, the protection of victims and the prosecution of offenders.

Still, according to the *Gender Barometer Romania 2018*, gender discrimination has been permanently refined: besides the well-known direct and indirect discrimination, in Romania can be found (i) multiple gender discrimination and (ii) ambivalent, ambiguous forms of sexism, such as subtle sexism or hidden (Benokraitis and Feagin, 1986), ambivalent sexism (Glick and Fiske, 1996, 2011), modern sexism (Swim et al., 1995) or neo-sexism (Tougas et al., 1995).

European Gender Equality Index 2019, ranks Romania 25th in the EU (54.5 out of 100 points) showing that Romania is progressing towards gender equality but at a slower pace than other EU Member States. Romania's scores are lower than the EU's scores in all domains of gender inequalities being the most pronounced in the domain of power (38.8 points), time (50.3 points) and knowledge (51.5 points). Also *Global Gender Gap Report 2020* ranks Romania 55th in the world showing very slow improvements. The report of

the Global Economic Forum of 2016 (WEF, 2016) indicates even a slowdown in the rate of progress of gender equality, being especially highlighted the increase of the gaps in the fields specific to the fourth industrial revolution - science and technology.

On the other hand, the World Bank's Romania Gender Assessment Report (2018) indicates a series of advances related to the presence of women in scientific fields considered male dominated and the creation of a legislative and institutional framework for addressing gender issues. Despite these advances, women are becoming more numerous in the NEET group (people who are no longer in the education system, but are neither employed nor follow any other form of vocational training) and the report is underlying the inequitable distribution of time for domestic activities among women and men.

Although very slow, a series of progress in the field of gender equality results from the Gender Barometer 2018 made in Romania: compared to 2000, more people accept the possibility of a women as the president of the country, and more people reject the idea that men are better able than women to lead or the one that women are too busy with household and have no time for management positions. Also, the percentage of women who do not trust their strengths decreases and the claim that women are afraid of great responsibilities is largely rejected.

The data collected for the 13 indicators that define 3 main dimensions of the *Women in Digital* Report: internet use, digital skills and employment and professional competences give controversially conclusion for Romania. On the one hand Romania placed on the last places for Internet use: 26th place with 30.9 points (50.2 EU average) and for digital skills: 28th place with 24. 5 points (53.1 EU). On the other hand, for the third dimension, the one regarding employment and professional competences, the situation is better, with Romania occupying the 13th place with 44.2 points (43.9 EU).

More paradoxical are statistical data that indicate a large difference between the number of women and men that complete a major in ICT (mathematics, statistics, computing and engineering). In the context, Romania is mentioned as a country with a smaller gender gap difference, despite the fact that the number of men population is almost three times larger. With a rate of only 3% female graduates out of the total number of graduates (as shown in Figure 1), Romania occupy a paradoxical (because of such a small percentage) and honorable first place.

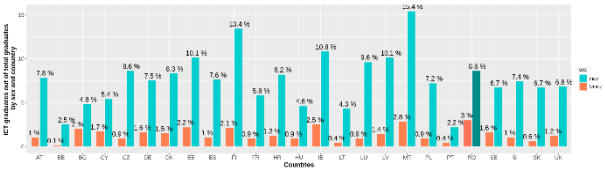

Fig.1 ICT graduates out of total graduates in 2015 by sex and country (Women in Digital Report, 2018:30).

Although there are a large number of women graduates in STEM areas compared to the other European countries, however, the number of Romanian women who complete doctoral level is really low, as shown in Figure 2, placing Romania in a cluster positioned on the penultimate place, only ahead of North Macedonia.

This situation needs further clarification - it is necessary to investigate the reasons why STEM women graduates in Romania are not oriented towards the deepening of the studies. Our hypothesis considers that the climate of Romanian technical universities may be much to traditionalist male-oriented institutions and not encouraging women to enroll in the next learning cycle.

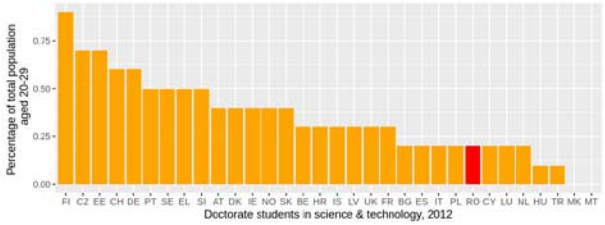

Fig 2 Women completing doctoral level (Eurostat data)

In addition, the employment opportunities for women in Romania are underwhelming (Figure 4), although there is a large number of graduates in these fields, as figure 3 reveals.

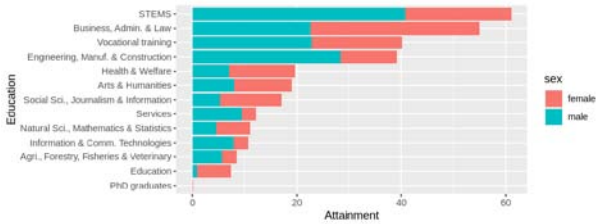

Fig. 3 Educational attainment in Romania (Global Gender Gap Report 2020, 295)

Explanations may be offer in terms of a more traditionalist culture in Romania which prefer men to work in such places, but also it is needed to analyze it as a percentage of the total available

workplaces as the existing law percent may reflect a poor development of industry

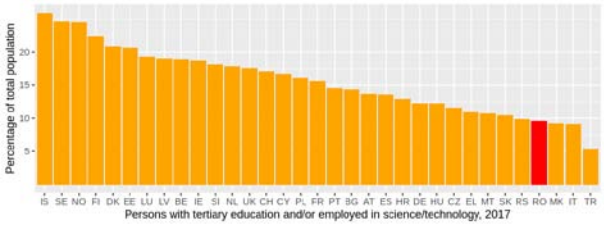

Fig. 4 Persons with tertiary education (ISCED) employed in science/technology (Eurostat data)

An alternative hypothesis would be that many of the women may leave STEM fields to work in other areas. But data give little support to this hypothesis as in Romania, 26.3% of the total number of ICT employees work are women in Romania, compared to the European average - 16.7% (Global Gender Gap Report 2020, 2018:295).

We notice that data collected from different sources gives an incomplete picture of the situation of STEM women in Romania, a mosaic completed at times, but with significant missing parts and with overlapping images. The data are not always mutually confirmed, and their interpretation sometimes seems subjective, bearing the imprint of authors' ideologies.

Gender Barometer. Romania 2018 points out a contradiction between the promoters of gender equality and the target population of these efforts: while 47.3% of women agree that "women often do not get jobs because they are women", yet 50.3% respondents agree that "gender discrimination is no longer a problem in Romania".

5. CONCLUSION

Although self-affirmation, self-realization of the individual must be the ultimate goal for the optimal organization of social coexistence, accommodating with a new state of the society requires considerable efforts. Many women working in STEM fields were exposed either to manifestations of indifference or to insults, ridicule, marginalization and clearly censorship and persecution.

The data presented in this paper gives us an overview of several important principles of social structure based on the criteria of gender. In order to have more in-depth information regarding the real motivations and feelings of women involved in STEM fields, it will be necessary to carry out the research regarding specific behavior of the female and their contextual contexts, as well as regarding their opinions and experiences. The TECIS group, which is at the origin of this work, intend to engage in the effort to succeed in carrying out such research at European level (Doyle Kent et al., 2020). Depending on the results, proposals can be made to improve serious situations and to generalize good practice for a future inclusive, competitive and performing Europe.

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