Chapter 7
Women's Empowerment as a Tool for Sustainable Development of Higher Education and Research in the Digital Age

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ABSTRACT

The chapter deals with the global issue of advancing women's role in higher education and research (HE&R) as a mechanism for reaching the Sustainable Development Goal 5 – gender equality. Gender analysis method is employed to identify historical and current differences between women and men relative to their participation in HE&R and access to decision-making and resources therein. The focus is on the global challenge of gender disparities, including horizontal and vertical segregation, the androcentric academic culture, and the gender pay gap. The authors warn of possible contamination of AI with human gender biases, which can be detrimental to academic hiring and assessment procedures. Summarizing gender-equality policies and practices available worldwide, the authors give recommendations on women's empowerment in HE&R on the global, national, and organizational levels.

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INTRODUCTION

On September 25, 2015 193 UN member countries agreed upon 17 Sustainable Development Goals (SDG) to transform the global society until 2030 (UN General Assembly, 2015). This chapter will focus on SDG 5 "Achieve gender equality and empower all women and girls" (p.18) with regard to higher education and research (HE&R) worldwide. Of special interest in this respect are the targets of combatting all forms of discrimination against women, eliminating gender-based violence (GBV), ensuring women's full participation in leadership at all levels of decision-making, providing equal access to economic resources and technologies, and adoption of policies and laws to secure women's empowerment. The progress towards achieving SDG 5 is accelerating, but still "no country has fully achieved the promise of gender equality" (Equal Measures 2030, n.d.).

This research contributes to the analysis of the worldwide deficit of gender equality in HE&R, which is specifically detrimental to the sustainable development in the digital age, when knowledge and technologies play a crucial role. The study applies gender approach as a method of abstraction from biological differences between men and women to concentrate on socially, economically and culturally significant inequalities between the sexes. This method is widely used in applied political and management studies as an efficient approach to the areas where change is needed.

…Gender analysis identifies the differences between and among women and men in terms of their relative position in society and the distribution of resources, opportunities, constraints and power in a given context. In this way, conducting a gender analysis allows for the development of interventions that address gender inequalities and meet the different needs of women and men. (European Institute for Gender Equality, 2019, p.3)

The gender analysis method applied in this chapter examines historic and present social relations in HE&R in gender perspective in order to identify inequalities between women and men in access to decision-making, resource allocation, and management. This chapter investigates which gender inequalities impede the development of HE&R worldwide and, based on the international experience, suggests recommendations for improving HE&R systems and organizations to ensure sustainable growth of the global economy of knowledge.

BACKGROUND

The international community of gender researchers in HE&R has shown an increasing interest in gender issues related with the production and transfer of knowledge. Despite a general consensus that gender inequality in academia does exist, such issues as women's participation in higher education (HE) management and decision-making, access to research funding, and gender disparity across study fields require more in-depth investigation. The established status quo should be questioned and revised based on the analysis of empirical data. The persistency of gender imbalance in global HE is aggravated by the general rigidity of the institutional cultures of universities (Shepherd, 2017). Investigating women's share and performance in HE&R is intrinsically connected with ideologies, gender equality policies, scientific quality, and academic practice (Powell, 2018), so any gender research should be put into a broader societal context.

Women's presence in HE&R occurs naturally today, but it is in fact an achievement of the long-standing movement for women's rights and gender equality that is referred to as "feminism." Women's access to education and research has been one of the gender-specific issues on the general democratization agenda, so the historical progress in this field should be framed within feminist theory. The core of feminist theory is the notion that gender is socially constructed and embraces the social expectations, beliefs, norms and stereotypes of a "typical man" (masculinity) and a "typical woman" (femininity). Feminist theory views gender as similar to class in that it has two manifestations: men and women. The genders differ in power distribution and social status, with men being the privileged, dominating, higher-status class, and women the subordinate, lower-status class with limited access to resources and political, economic and human rights (Else-Quest & Hyde, 2018).

A major challenge for sustainable development is the social omnipresence and historical persistence of gender inequality, which had been erroneously explained as caused by natural sex differences until gender theory offered a theoretical base for deconstructing the asymmetric power relations between the genders. Feminist theory has uncovered the pervasiveness of gendered thinking which uncritically assumes that gender and certain social roles (e.g. leadership in organizations) are necessarily linked. Gender as a social construct is reinforced and reconstructed in everyday social practices and institutional structures including HE&R institutions. Since it is socially constructed, gender is not static but dynamic. The asymmetry of power relations between the genders can be diminished or eliminated by modifying decision-making processes, rules of conduct, and institutional structures (Carvalho & de Lurdes Machado, 2010; Shepherd, 2017).

Development agencies and organizations such as UN, UNESCO, UNECE, UN Women, World Economic Forum (WEF), European Commission, European Institute

for Gender Equality, etc. pursue gender equality strategies, closely monitoring their implementation in various areas. One of key monitoring indicators is the Global Gender Gap Index (GGGI) measured by WEF (2019). Iceland, Norway, Finland, and Sweden are ranked as global leaders by GGGI. Promotion of gender equality in HE&R has been an important part of the Nordic countries' policies since the 1980s. As a result, Sweden, Norway, and Finland currently have the highest proportions of female university rectors in Europe (European Commission, 2019).

Albeit WEF (2019, p.6) expects the global gender gap to close in 99.5 years, some countries according to UNESCO Institute for Statistics (UIS, 2020) have already come close to gender balance in HE&R, with women's share in specific aspects ranging between 45% and 55% (Table 1). Researchers investigate national HE&R systems from different gender-sensitive perspectives classified at the end of this section. Several countries and regions that are usually less covered are discussed below.

The gender imbalance in Ukrainian universities exemplifies sharp vertical segregation with overwhelming female majority at the bottom of hierarchy, approximate balance at the middle level and male prevalence at the top. Such gendered distribution of power in HE corresponds to the low women's participation in decision-making, as the structure of Ukraine's 2018 GGGI score shows. Given the lack of top-down gender equality strategies in HE, women's grass-root initiatives coupled with female academic networking are considered key for success (Kolomiyets-Ludwig & Kurchenko, 2018).

Female academic opinion leaders and civil activists take the lead in promoting gender equality in China. In 1945-1980s, the All-China Women's Federation was the only official body to protect women's rights in the country. After the World Women's Conference in Beijing (1995), female professors play the leading role in combatting gender discrimination and GBV. Due to communist regime and NGO suppression, the latest surge of the women's empowerment movement in China is characterized by use of non-formal online communication channels instead of official documents or academic publications (Wu & Dong, 2019).

Women's participation in African universities is exceptionally low. In the African Commonwealth, women comprise 25.3% of academic staff above the senior lecturer level, and only 9.8% of top executives. As the minority in HE, women feel excluded and deprived of friendly socializing, their needs are often ignored, and GBV against female staff and students receive no institutional response (Aina, 2013).

In Latin American countries gender disparity in HE&R is expressed rather qualitatively than quantitatively. While women prevail among tertiary students, and university teaching staff is approximately gender-balanced, three issues raise concern: unequal distribution of high-ranked positions between women and men, sexual harassment of female students, and female faculty's exposure to abuse of power by men. The machismo culture and criminalization of society result in violence against

Table 1. Countries nearing gender balance in HE&R by share of women, % (2013-2018 average)

Country*	Tertiary Education			R&D personnel
	teachers or professors	natural sciences, mathematics & statistics students	STEM graduates	
Armenia	57	55	38	52
Australia	44	48	31	-
Austria	42	47	25	30
Belgium	47	-	26	36
Canada	-	53	32	-
Chile	42	45	19	38
Colombia	37	50	34	-
Denmark	42	51	34	38
Finland	51	50	27	34
Georgia	53	-	44	53
Germany	38	45	27	32
Hungary	41	50	31	39
India	39	49	42	-
Israel	-	48	-	-
Lao	38	51	25	-
Mexico	-	50	31	33
Mongolia	60	50	35	52
Morocco	25	47	45	32
New Zealand	49	53	35	-
Norway	45	50	28	39
Portugal	44	55	40	44
Romania	49	-	41	46
Spain	41	50	29	40
Sweden	44	50	34	36
Turkey	42	51	35	35
UK	44	53	38	36
Ukraine	-	-	29	48
USA	49	52	33	-
Viet Nam	49	-	39	45

Source: authors' calculations based on UIS.Stat (2020)

* Countries where at least one of the four parameters fall into the 45-55% corridor.

women and their discrimination and disrespect in HE&R (Maldonado-Maldonado & Acosta, 2018, p.3).

Australia is a continent with a strong feminist tradition and early achievements in gender parity, where gender proportions in HE have been monitored since the mid 1980s, Within thirty years of gender mainstreaming, women's share has risen from 20% in academic staff and 6% in senior positions at the starting point to 44% and 31% by 2015, respectively (Winchester & Browning, 2015). Obstacles to gender parity in senior positions in Australia include poor representation of women in decision-making bodies, male-dominated value system in research and funding prioritization, family constraints, cultural impediments, and women's lower application rate for promotion (Carrington & Pratt, 2003).

At present, research on gender in HE&R is looking at the following aspects:

- Unequal distribution of women and men across study fields, i.e. horizontal segregation (Armstrong & Armstrong, 2010; Cornish & Faraday, 2004; Peterson, 2015; Smith & Nosek, 2015);
- Women's poor advancement through the academic and management ranks, i.e. vertical segregation (Peterson, 2015 ; David, 2015; O'Connor, 2015);
- Androcentric, i.e. men-focused, culture in HE&R institutions (Carvalho, 2010; Castilla & Berhard, 2010; Kaatz et al., 2015; Shepherd, 2017; van den Brink & Benschop, 2014);
- Perpetuation of male bias through the application of androcentric AI in assessment and promotion procedures (O'Neil, 2016; Shepherd, 2017; Tannenbaum et al., 2018);
- Gender pay gap in HE&R (Baily et al., 2016; Carnevale, Smith & Gulish, 2018; Chen & Crown, 2019);
- Insufficient female access to research funding and publications in high-ranking journals (Cornish & Faraday, 2004; Grogan, 2019; Moss-Racusin et al., 2012); and
- Local or regional specifics of gender equality (Aina, 2013; Dranzoa, 2018; Kolomiyets-Ludwig & Kurchenko, 2018; O'Connor, 2015; Winchester & Browning, 2015; Wu & Dong, 2019; Maldonado-Maldonado & Acosta, 2018).

Against this background, it is important to highlight deficits underlying gender inequality in HE&R and to suggest measures to be taken at the international, national and institutional levels to empower women and achieve gender balance in academia as a prerequisite for sustainable development.

CHALLENGES FOR ACHIEVING GENDER EQUALITY IN HE&R

Origins and Status of Gender Disparity in Higher Education

The expansion of gender equality is a regionally and historically asymmetric process interrelated with ideological and socio-economic changes. From a historical perspective, the rise of gender equality has been accelerating since the 19th century, when secondary education for women was broadly introduced in Europe and North America. The wave of revolutions in the early twentieth century was accompanied by a surge in the movement for women's voting rights and access to HE. The democratization wave in the 1960s led to a total reframing of the age-old concepts of women and sex, shifting focus from women's biological to their social characteristics, from women as subjects of the reproductive family and household work to full-scale participants in society and productive work, including the production of knowledge.

The surges in the movement for women's equality are known as the waves of feminism. There is debate on whether there have been three waves of feminism or four. An analysis of women's role in HE&R as a crucially important field in the digital age leads to the conclusion that the fourth wave of feminism did indeed start in 1995 and is still going strong. The current stage of women's empowerment is characterized by its high efficiency, achieved through legal frameworks and institutionalization. Women's increasing accomplishments in tertiary education and knowledge production as well as their strengthening economic position have an unprecedented impact on sustainable development.

Until the Enlightenment, women were restricted from accessing HE based on the belief that they are intellectually inferior and belong at home with the family. An early feminist Mary Wollstonecraft, while advocating women's right to education in *A Vindication of the Rights of Woman* (1792), maintained that women's place was at home and that well-educated women would make better wives and mothers (Dentith, 2016).

The pioneer in granting women access to HE as both students and teachers was the University of Bologna, Italy (founded 1088), where Bettisia Gozzadini supposedly attracted crowds with her lectures in the early thirteenth century. However, the first official record of a woman teaching at the university of Bologna is dated 1732, when Laura Bassi earned a chair in philosophy (Alma Mater Studiorum - Università di Bologna, 2019).

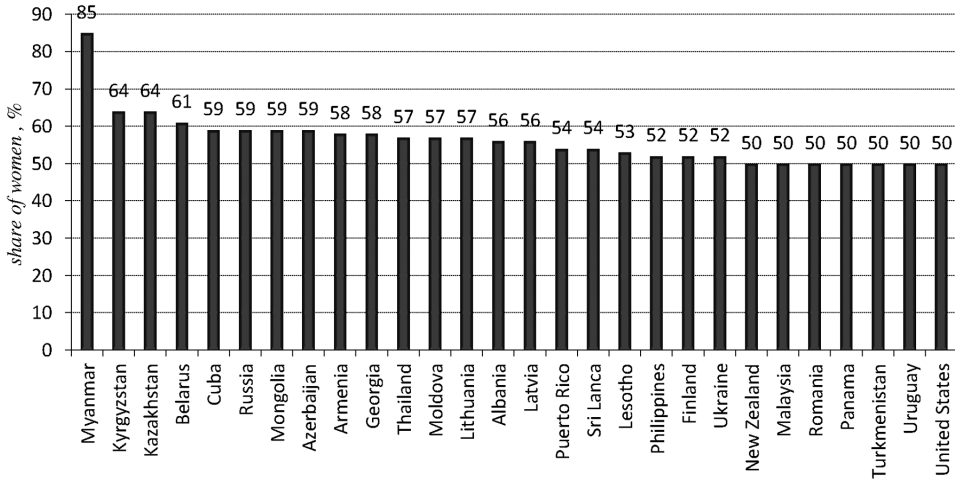
Women's access to education was the key achievement of the **first worldwide wave of feminism** (1860s–1880s), when sex-segregated basic and secondary schools were introduced in the U.S., Russia, and Europe (Dentith, 2016). Wesleyan College (U.S.) claims to be the world's first higher education institution (HEI) providing bachelor's degrees to women since 1836. In the 1860s female students officially

gained access to universities in Europe, initially in Switzerland (Zurich, 1868), and in 1870-1880 in Northern Europe, Austria, Italy, France, Netherlands, and Russia (Lange & Klemm, 1901). Oxford colleges have been admitting women as students since 1879 but as teachers since 1920 (Women at Oxford, 2019), and only in 2015 did the last Oxford all-male college open its doors to women. It has taken women a lot of time and effort to establish themselves as university faculty. Sofia Kovalevskaya (University of Stockholm, 1884, professor of mathematics) and Ellen Richards (MIT, 1889, associate professor of chemistry) paved the way for women in university teaching.

The **second wave** of feminism (1890s–1920s) resulted in gaining voting rights by women. Women's right to vote was initially recognized in New Zealand (1893), followed by Australia (1902), Finland (1906) and Norway (1913), Denmark and Iceland (1915), and Canada (1917). The second wave culminated in 1918-1924, expanding women's political, labor and education rights in Europe, Central Asia and the U.S. (Inter-Parliamentary Union, 2020). In the following years a significant state-owned social infrastructure was created in socialist countries to provide decent childcare and pre-school education outside the family context to free up women so they could participate in the labor market, HE and research activities. Strikingly, to this day established Western democracies are overtaken in the area of women's

Figure 1. Global leaders by share of women in tertiary education faculty, 2018 or earlier available

*Source: compiled after UIS. Stat (2020) and Kogut (2014). * Only countries with population over 1 mln included.*



share in HE teaching by economically less developed countries in the regions of South Asia and the ex-USSR (Figure 1).

The **third wave** of feminism (mid 1960s–1995) started in the U.S., expanding into Europe, Australia, and Asia in the mid 1980s. It aimed to eliminate gender-based discrimination and women's cultural and social inequalities. This period is marked by a growing theoretical interest in gender disparity and by the creation of a new paradigm known as gender studies that led to a major rise in gender awareness. The first fundamental global action specifically protecting women's human rights, including the right to education, is the *Convention on the Elimination of All Forms of Discrimination against Women* (CEDAW, 1979). Its article 10 outlines the legal obligation to eradicate discriminatory gender barriers in education, ensure equal access for women and men to all types of educational programs and institutions, eliminate stereotypical concepts of women's and men's roles in education, revise curricula, provide equal access to study and research funding, and create equal opportunities for life-long learning and work-life balance (UN Human Rights Office, 1979).

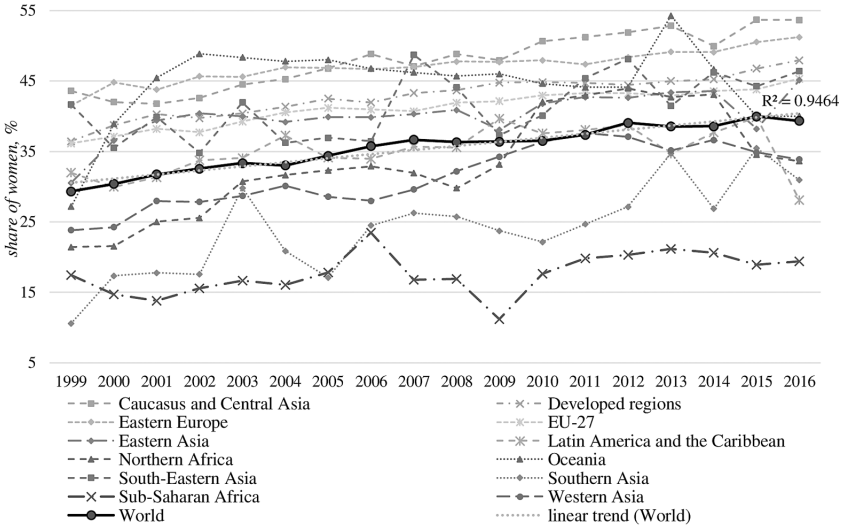
The start of the current **fourth wave** of feminism is linked to the Fourth World Conference on Women in Beijing in September 1995, where 189 countries committed to advancing women's rights including empowerment through education in the *Beijing Declaration and Platform for Action* (1995). The global commitment to tackle the issue of gender-based discrimination in education was reinforced in 2015 (UN General Assembly, 2015). UN Women (2017) introduced the concept of the tripartite human rights framework in education: access rights to education through equal numeric representation of both genders in education, rights within education through creating equal opportunities and elimination of gender hierarchies in education, and rights through education gender equality in other aspects of life to prevent situations where women and men receive different financial and social benefits in spite of equal certification. Globally, even when their educational achievements are lower than those of women, men occupy better positions (UN Women, 2017).

The proclamation of a global anti-discriminatory gender policy in the 1995 *Beijing Declaration* was a watershed for women's participation in HE. Since the 1990s, more women are completing tertiary education than men. Female HE graduates outnumber male graduates in 76% countries as of 01.01.2019. However, female prevalence is inversely proportional to educational level. Globally women account for 54% of bachelor's and 55% of master's degrees, but at higher levels the trend reverses: men account for 54% of PhD graduates and 71% of researchers (UNESCO, 2019).

Calculations show women's share in HE faculty gradually rising about 0.55% per year in the world since 1999. The sources of growth are distributed unevenly, Northern Africa and Oceania being the leaders of growth, while Eastern Europe and Sub-Saharan Africa have the slowest dynamics (Figure 2). At the same time Eastern Europe is the most homogenous region with the lowest standard deviation

and together with Caucasus, Central Asia and developed regions is close to the ideal situation when the share of women in HE&R is equal to the national demographic level. Data from the Chinese region of Macao show that even within regions of one origin considerable differences may occur (up to 10% in this example).

Figure 2. Global dynamics of average women's share in tertiary education faculty by region, 1999-2016
Source: compiled after UIS. Stat (2020)



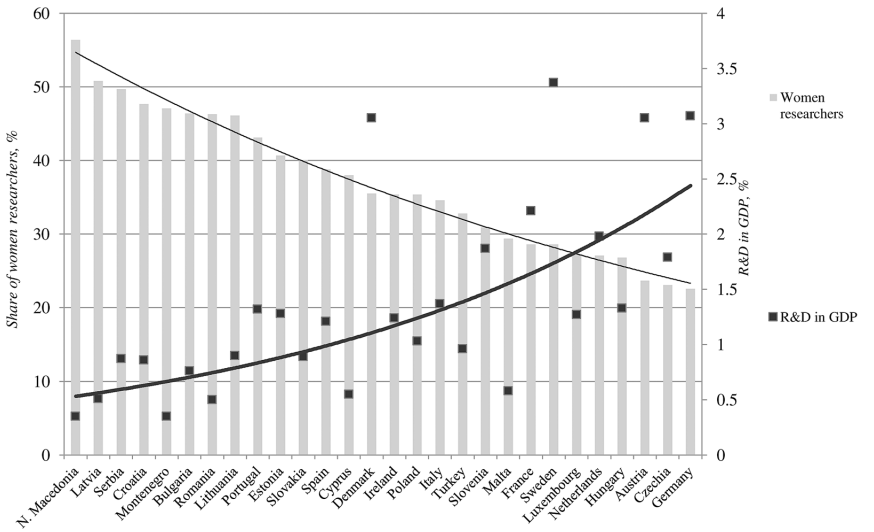
Women are considered to make up 29% of researchers worldwide (UIS, 2020), but this average is based on data of just 133 out of 235 countries. Central Asia, Latin America and the Caribbean are the best performers with female researchers making 45%. Sixteen countries reported a women's share in research above 50%: Argentina, Armenia, Azerbaijan, Georgia, Guatemala, Kazakhstan, Kuwait, Latvia, Lithuania, Mongolia, Myanmar, North Macedonia, Panama, Thailand, Tunisia and Venezuela. Their achievements are all the more remarkable considering that the Scandinavian countries, otherwise leaders by GGGI, have only attained the 33–38% range, not to mention Germany and France, with 28 and 27%, respectively. However, the highest percentage of women in research is registered in countries with the lowest levels of R&D financing, whereas countries with higher levels of R&D financing show lower participation of women (Figure 3).

Horizontal Gender Segregation

Women's low presence in high-ranking HE&R positions and restricted access to decision-making in the knowledge industry are the main obstacles on the way to gender equality and sustainability not only in the intellectual sphere but also in society in general, because HEIs are where future professionals and leaders are made. Across the world, statistics reveal a gender imbalance in HE&R in the form of both horizontal and vertical segregation. Horizontal segregation means women's and men's uneven distribution across a set of occupational fields or fields of study. The horizontal segregation in HE&R may appear to be due to people "freely" choosing a profession or field of study, but in reality it is largely determined by social stereotypes that assign social sciences and humanities (SSH) to women, and science, technology, engineering, and math (STEM) to men (Smyth & Nosek, 2015).

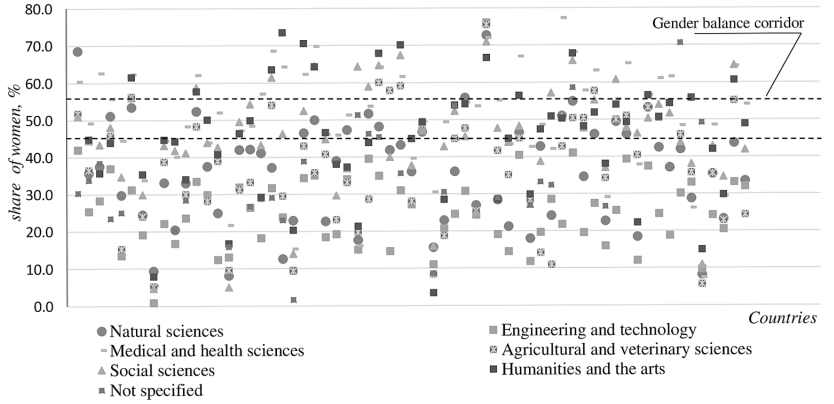
Women's representation in STEM differs across countries and regions, with less-developed economies sometimes outperforming global economic leaders. In 2016, female doctoral graduates in the EU were overrepresented in education (68%) but underrepresented in IT (21%) and engineering (29%) (European Commission, 2019). The same year saw female researchers in Ukraine dominating in humanities

Figure 3. Tendency in women's participation in research and R&D funding, 2017
*Source: compiled after the Eurostat (2020). * All countries presented with both indicators in the Eurostat database are displayed.*



(61.5%) and the social (64.6%), medical (63.8%), and agrarian (54.9%) sciences while being underrepresented in the natural (43.4%) and technical (34.2%) sciences (State Statistics Service of Ukraine, 2017, p. 55). Women's low presence in study fields that are crucial for the digital economy is a major challenge for the sustainable development of the information society and for women's welfare in the future (Figure 4).

Figure 4. Distribution of women's share among researchers by sciences in countries with data available
Source: compiled after UIS. Stat (2020)



The danger of horizontal segregation lies in the fact that female presence in a job area and low pay are linked (Armstrong & Armstrong, 2010). Based on labor-market statistics, Cornish and Faraday (2004) claim that women's segregated work is consistently paid less than men's. Thus, the more women are concentrated in a job, the less they are paid, with little regard for the value of their work to the employer or the consumer. This phenomenon affects the wage difference between the male-dominated STEM field of studies and the female-dominated SSH field. Although Dubois-Shaik and Fusulier (2015) try to explain the gap by prestige and social pressure on men to be breadwinners, the explanation offered by Armstrong and Armstrong (2010) and Cornish and Faraday (2004) is more conclusive and evidence-based. Hence, attracting more female students, teachers and researchers into STEM will not only increase women's participation in global wealth in the near future, but it will also decrease the workforce cost in the digital sector in the long

term. The feminization of professions, however, often carries with it the risk of loss of prestige, fewer advancement opportunities, and weaker job security (Peterson, 2015).

Another case of horizontal segregation is the uneven cross-sector distribution of male and female researchers between lower-paying HEIs and higher-paying corporate R&D departments. Female researchers tend to work in the academic and public sectors, while men dominate the better-paying and more opportunity-rich private sector. In Argentina, for example, women account for 53% of researchers in the public sector, but only 26% of researchers in the private sector (UNESCO, 2019).

Vertical Gender Segregation

Vertical gender segregation refers to the ranking of the workforce with regard to occupational positions and determines the income and power distribution between men and women. Vertical segregation is of much more concern than horizontal segregation from the perspective of social justice, academic ethics, and meritocracy. Persisting gender inequality in academic advancement leads to unfair distribution of funds and aggravates the gender pay gap in HE&R (Armstrong & Armstrong, 2010; Chen & Crown, 2019; Kaatz et al., 2015). Universities lose a significant amount of talent due to the "leaky pipeline" of female academic careers (Dubois-Shaik & Fusulier, 2015; Gvozdanović & Maes, 2018). Across continents and study fields, research shows women's share decreases with every step up the academic ladder, plummeting in the highest-paying and most secure positions (full professorships or grade-A positions). Women's share in chief-executive positions in HE&R is critically small, although it is growing in response to the implementation of gender equality policies (EC, 2019).

There is growing evidence from business research that women's participation in management correlates positively with corporate incomes and overall performance (Bodin et al., 2019; Misercola, 2016; McKinsey, 2019), still women consistently face barriers in management, especially in leading positions. Vertical segregation is a matter of cultural tradition and is strongly impacted by gender stereotypes and biases.

There are some critical points along the "leaky pipeline" of female careers in HE&R:

- Women are less likely to be hired by male-headed organization units – in an experiment by Moss-Racusin et al. (2012) male candidates for a laboratory manager position were rated as more competent than female candidates with identical CVs and were offered starting salaries US$4,000 higher than women;
- Women are half as likely to be given excellent letters of recommendation (Grogan, 2019);

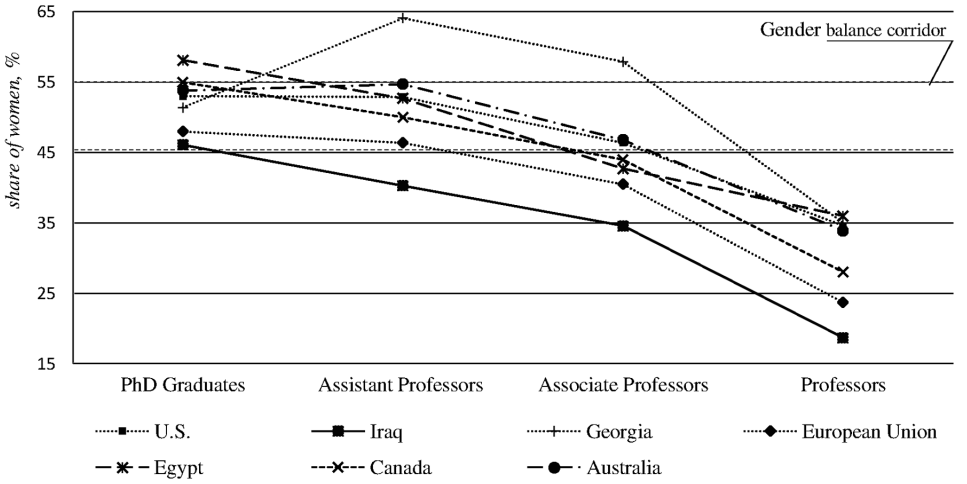
- Women receive less funding for scientific projects: they submit fewer grant proposals, but once they do, they are equally successful in obtaining grants (Grogan, 2019);
- Women are less accepted as scientific authors and comprise roughly 30% of all authorships in high-ranking research journals, with the likelihood of being published decreasing as the journal's ranking increases (Bendels et al., 2018).

Remarkably, South American and Eastern European countries demonstrate greater gender parity in publications registered in the Thomson Reuters Web of Science databases (Lariviere et al., 2013). 17% of countries have an equal number of male and female scientists, but only 6% come close to achieving gender parity in terms of papers published. Female authors dominate in just nine countries, including Macedonia, Sri Lanka, Latvia, Ukraine, and Bosnia and Herzegovina. In the case of Ukraine, women publish more than men in Thomson Reuters despite being the minority (45%) among researchers (UNESCO, 2019). As a compound reflection of the barriers facing women and the female talent leak in HE&R, of the 601 people who won science-related Nobel prizes from 1901 to 2018, only 21 (3.5%) were women. The year 2018 marked the first time the Nobel committee asked nominators to include gender in their considerations (Grogan 2019).

The biggest leak in the academic pipeline occurs when women move up the ranks from associate professor to full professor (Figure 5). At this stage in their careers, women typically feel more strongly the pressures of their family responsibilities and the loss of support from mentors and networks (Buckles, 2019). The critical organizational or academic level above which women have difficulty rising is referred to as the "glass ceiling". Statistics from all over the world except Africa show that in HE&R the glass ceiling is situated between associate and full professorships. Any further rise above the glass ceiling—be it getting a professor title, tenure contract, civil-servant status, subordinate team, research endowment, leading management position, honorary title or prize nomination—puts up additional barriers for women, leading to their numbers rapidly diminishing at the top of the academic hierarchy.

Gender equality and female advancement policies implemented in developed economies since the mid 1980s are steadily increasing the share of women in HE&R, and the glass ceiling is gradually rising. However, the quantitative increase of women in higher management positions is partially attributed to the phenomenon known as the "glass cliff", "when women are more likely to be appointed to precarious leadership roles in situations of turbulence and problematic organizational circumstances" (Peterson, 2015, p. 1).

Figure 5. Global vertical gender segregation in the academic hierarchy
Source: authors' compilation, Catalyst (2020); European Commission (2019); UIS. Stat (2020)



Androcentric Academic Culture

Male Bias

Modern universities are often conceived as knowledge-production hubs connected with all other industries and aiming at global competitiveness, while standard organizational management principles and procedures are gaining ground in the knowledge economy (Ilnytskyy, 2016). In HEIs as in the corporate sphere, women's progression towards higher management levels is consistently impeded. A major U.S. corporate study (McKinsey, 2019) has revealed that negative expectations prevent young female talent from entering managerial careers. With only 72 female managers being hired for every 100 men and the ratio of female managers decreasing at every higher level, gender disparity is perceived as a social norm. Men and women have different views of the causes preventing women from attaining senior leadership positions: 32% of female vs. 12% of male employees maintain that women receive less sponsorship. While 40% of women think to be judged by different standards, only 14% of men agree. The widely held misconceptions that women are less likely to aspire a management position or to do what it takes received the least support (1% and 6%) (p. 13). More importantly, women display less willingness to compete *against men* when stakes are high (van Dolder et al., 2020).

The self-perpetuation of male bias in rule setting in the knowledge-production sector as a whole is an important and relatively new field of study. Androcentric academic culture favors male candidates due to the historically inherited social

stereotypes of men's intellectual and managerial superiority over women. Stereotypes are usually not perceived unless contrasted with another culture and are mainly interpreted as the normal state of things. The mechanisms by which stereotypes operate are so powerful that they can cause people to make choices contradictory to their own conscious beliefs, as proven by the Implicit Association Test (Project Implicit, 2019). Stereotypes are inherited with culture, as shown by Miller, Eagly and Lynn (2015), who asked 5,000 American and Canadian children to draw a picture of a scientist and received only 28 (0.6%) female images in response.

Androcentric institutional culture is perpetuated, and female career progression impeded by male academic gatekeeping, i.e. men controlling information about and access to vacant positions, thus determining who is included in or excluded from recruitment and promotion procedures (van den Brink & Benschop, 2014). Gatekeeping facilitates the gendered distribution of resources, information and opportunities in HE&R. Male decision-makers prefer to mentor and advance male colleagues, and senior management is stereotypically regarded as a masculine job sometimes regardless of women's better performance (Player et al., 2019).

Aware of biased social norms and double standards, women typically do not even seek full professorships nor do they apply for senior management positions in HE&R. Boustan and Langan (2019) have shown the positive effect of female role models, female mentoring, and a supportive leadership style on the sustainability of women's academic careers. Men's aggressive leading, communicating and competing styles coupled with double standards in the assessment of men and women are regarded destructive factors. One should distinguish between *mentoring* as sharing knowledge and *sponsorship* as sharing power, typically when advocating for promotion, whereas "women tend to be over-mentored and under-sponsored" (Ibarra, 2019).

Those women who dare to pursue academic management careers and succeed consider top executive positions in universities attractive and aspire to promotion, motivated by the prospect of taking decisions, making a difference, and exercising positional power (O'Connel, 2015; Shepherd, 2017). However, most women in male-dominated academic cultures such as STEM tend not to recognize the structural and cultural reasons behind their hampered careers and attribute occasional setbacks to their own underperformance even when this is objectively not the case. Although gender-based discrimination in academic culture is systemic, female academics tend to write off instances of blatant sexism as random aberrations. On the other hand, women who do manage to advance in male-dominated spheres tend to exaggerate their own merits and contributions (Seron et al, 2018).

The Meritocracy Paradox

Further up the ladder of women's academic career success, especially above junior professor level, progress is largely hampered by implicit gender bias in evaluations. Comparing male and female academic career progression across Europe, Gvozdanović and Maes (2018) proved that "assessment procedures in academia, which proclaim to be based on meritocracy, are in fact biased and disadvantageous to female scientists" (p. 14). This bias rests on preconceived notions about leadership and science that are deeply rooted in culture and determine the unequal distribution of academic resources. It leads to a perverted application of meritocracy, giving women less opportunities to achieve leading positions than equally qualified men. This bias is particularly strong in academic recruitment, retention and career advancement, and in the allocation of research funding (Gvozdanović & Maes, 2018).

The "meritocracy paradox" refers to the tendency of managers who consider themselves to be working for meritocracy-driven organizations to take biased decisions. This paradox was described by Castilla and Bernard (2010) after an experiment that showed participants who were supposed to act as meritocrats actually awarded male employees with bonuses on average 12.5% higher than female employees for equal performance. In contrast, participants from supposedly gender-biased institutions favored female employees, while the control group took gender-neutral decisions. Apparently, organizations openly embracing meritocratic values may quite counterintuitively be promoting the opposite, bias in favor of men. A way to mitigate this would be by reducing managerial discretion and increasing accountability and transparency.

As exemplified by Seron et al. (2018), women in engineering studies experience their marginal position and internalize the dominant values of meritocracy and individualism, which leads them to justify their individual experiences of gender discrimination in distribution of status and funding by those values and to perceive non-meritocratic environment as meritocracy.

Gender stereotypes in male-dominated domains include expecting men to be more competent than women, which leads evaluators to give women greater praise than men for the same performance but also to favour men when it comes to allocating research funds. Using quantitative linguistic analysis, Kaatz et al. (2015) detected how male bias manifests in the assessment of research-funding applications. While female researchers received more positive verbal assessment, they obtained fewer funding approvals than their male colleagues. Getting funding renewed is an even more difficult task for female researchers, who are challenging two male-dominated domains at once: science and leadership. Therefore, in order to prove their competence, female scientific leaders need to outperform the highest possible standards (Kaatz et al., 2015).

It is important to understand the extent of male bias in HE&R assessment indicators and standard hiring and advancement procedures. Requirements such as international mobility and having an interruption-free career exert a long-term negative impact on women who have families and children. Even if a woman diligently carries the double burden of work and family, demonstrating academic performance equal to that of a man, the probability of a man receiving preference is higher due to the preconceptions that men are better suited for leadership and women prefer family to work. Such biased hiring and promotion practices are detrimental not only to quality and social responsibility in HE&R but are also damaging to sustainability, including demography, as, in the light of opportunity cost theory, ever more women prefer obtaining economic benefits to the restrictions of childbirth (Raymo et al., 2015).

AI Contamination with Male Bias

In the digital age, humans' male bias and gender stereotypes have been transferred to artificial intelligence (AI). AI systems learn to make decisions based on the analysis of historical data, often inheriting the biases contained in them. While men constitute the vast majority in the IT branch, its products reflect the values and attitudes of their male creators. When Amazon involved AI in its recruiting system, the program automatically downgraded applications from women because the input data from the ten-year period indicated that the tech branch was a male sphere. Algorithms, i.e. standardized processes for solving math problems, use biased social input data and produce biased output solutions, thus reinforcing discrimination (O'Neil, 2016). High-income vacancy ads (Datta et al., 2015) and STEM career ads (Lambrecht & Tucker, 2019) are more often displayed to men, which undermines fair labor-market competition.

Androcentric research culture affects the quality of scientific results. For example, facial-recognition algorithms confuse the sexes when persons are performing roles contradictory to gender stereotypes, e.g. mistake a man in a kitchen for a woman. Gender-biased engineering solutions can even endanger women's lives. An analysis of the 1998–2008 US car-crash data revealed that female belt-restrained drivers faced a 47% higher risk than male drivers due to safety design using the average body mass and measurements of men (Tannenbaum et al, 2019).

While humanity has developed instruments of counteracting to explicit gender-based discrimination, machine learning uses large volumes of existing data, which are implicitly loaded with gender stereotypes and even encoded in language that makes male forms to the generic norm and female forms to specific deviations. Word order (man/woman, he/she), gender-biased descriptions and metaphors, lower female presence in texts also cause algorithms to discriminate women (Leavy, 2018). The risk of perpetuation of male bias in AI should be mitigated through algorithmic

techniques to prevent discrimination and through fairness-aware data-mining design (Hajian et al., 2016).

Given the increasing deployment of AI for research and HR procedures, the danger of programmed biased decisions will persist. Counteraction measures should include:

- measures to achieve gender balance among AI developers, testers and certification authorities;
- using gender-disaggregated data and analysis;
- incorporating the UN's gender-equality-framework principles, relevant national legislation, and corporate gender equality policies into AI algorithms; and
- applying individualized algorithmic fairness strategies (disaggregation, exclusion, levelling or reversal of gender features).

Gender-Based Violence

Gender-based violence (GBV) is a global issue representing the extreme manifestation of androcentric culture. The most frequent form is violence against women encompassing physical, sexual, psychological, and economic violence. It includes femicide, human trafficking, harassment, rape, assault, social norms that devalue women, discriminatory laws etc. (OECD, 2019). On average in OECD almost one woman in three feels not safe when walking alone at night, in Latin America the figure stands at one in six women, and in Brazil and South-Africa women's unsafety reaches over 70% (p.126).

Worldwide, 35% of women have experienced sexual or physical violence, and 7% have been sexually assaulted (World Bank, September 25, 2019). 99% of Egyptian women experience sexual harassment (Dranzoa, 2018). HE&R institutions are not isolated from the cultural norms of their societies. While cases of GBV in HEIs are reported worldwide, African, Latin American and Islamic countries are disproportionally hit by the systemic violation of women's basic human rights in all spheres, including HE&R.

Developed countries are also hit by GBV in HE&R. According to National Academies of Sciences, Engineering, and Medicine (2018), over 50% of female academic staff and 20-50% of female students have experienced sexual harassment in the U.S. The risk of harassing behavior increases with male domination in authority positions, organizational tolerance and silencing, hierarchical teacher-student relationships, and isolated spaces. Reporting harassment is the least common reaction in academia due to fear of retaliation or dependence on the perpetrator for advancement. Instead, women give up leadership aspirations or leave the institution. The system of meritocracy fails to prevent GBV-related female talent loss and

decline in productivity. A survey of 34 HEIs from Germany, Italy, Poland, Spain and UK revealed that 29.3%-47.3% of female students experienced sexual violence, 47-68% were sexually harassed and 41-58% were stalked within the studying period, whereby in 40-60% of cases the perpetrators were male students and in 7% – HEI staff (European Commission, 2012).

Digital communication technologies gave rise to cyber-forms of GBV which are rapidly spreading and disproportionately harm women (European Institute for Gender Equality, 2017). On the positive side, big-data technologies are feasible of detecting GBV-related content. ICT have enabled digital feminism as worldwide protest against GBV. Hashtag campaigns, e.g. #MeToo, #Aufschrei, #MiPrimerAcoso, demonstrated significant potential of raising cross-border online and offline feminist movements by "interplay of individual stories and collective modalities enabled by digital platforms" (Baer, 2016, p.17). Social media campaigns help to combat silencing of GBV. In this framework, female students of prestigious Mexican universities massively accused male faculty of harassment and pressure for sexual favors. The protest leads the universities to elaborate formal procedures against power abuse (Maldonado-Maldonado & Acosta, 2018).

International development agencies and HE&R institutions are constantly improving their actions to eliminate GBV. However, the issue requires further academic investigation and rigorous countermeasures.

Gender Pay Gap

The logical consequence of women's subordinate position and diminishing representation as they rise in the management hierarchy is their restricted access to organizational and financial decisions. A successful modern academic career is hardly possible without intensive research and numerous publications in high-ranking international journals, but funding and publication decisions are predominantly taken by men and, as shown earlier, ostensibly meritocratic selection procedures still tend to benefit men.

The gender pay gap (GPG) describes the difference between the average wages of male employees and the average wages of female employees over a specific time period or at a given point in time. This monitoring indicator is widely used to measure economic inequality between the genders. Globally, no country, even among those with high GGGI rankings, has achieved gender equality in pay. The world GPG average stands at 15% (WEF, 2019, p. 17), meaning women on average get paid 15% less than men for equal work.

Evidence of persistent GPG is provided by numerous HE&R institutions throughout the world. Based on Ohio State University faculty salary data from 2006 to 2016, Chen and Crown (2019) identified a GPG of 21.4% that could not be explained by

differences in labor-market characteristics. The researchers attributed 27% of the identified pay gap between male and female faculty to discrimination. In particular, appointment type (instructor vs. academic) and faculty rank appeared to be the largest sources of discrimination.

A survey of 8,000 Australian academics has provided evidence that discretionary and higher duties allowances in academic pay or bonuses are unevenly distributed between women and men. Discretionary pay is especially susceptible to gender influences. Such deliberate wage distribution in favor of men can be explained in terms of regulation distance and the meritocracy paradox (Baily et al., 2016). Moreover, women in academia are inclined to do more service work and to, therefore, stay internal and not be promoted. According to Babcock et al. (2017), women are 50% more likely than men to perform "low promotability" or volunteer tasks. Women's inclination to volunteer and low visibility are detrimental to their academic careers.

While women use education and academic excellence as a key method for achieving higher wages, this strategy has failed: the total increase in women's share in all post-graduate education levels has not translated into a proportional increase in earnings. To the contrary, GPG increases with rising academic level (Carnevale, et al., 2018). Disparity in pay intensifies over the course of the typical female academic career, reaching its maximum at the end. In the U.S., a male bachelor's annual earnings increase by 87% over his career vs. 51% increase for a female bachelor, albeit women outnumber men in master and doctoral degrees. GPG is largely attributable to women choosing lower-paying industries and occupations, whereas education reduces the gap by 7%. The largest part of the GPG (41%) "captures discrimination that women experience in the workplace, whether outright sexism or unconscious, systemic, and socially entrenched prejudice" (p. 10).

The GPG hits HE&R as much as any other field of human activity, and the higher the educational level of women, the larger the GPG. The stalling progress in eliminating economic gender disparity (WEF, 2019) may be caused by the controversial effect of women's growing achievements in HE, which are inversely related to women's earnings as compared to men's – this issue requires further investigation. However, in some European countries the GPG has reversed in favor of women.

SOLUTIONS AND RECOMMENDATIONS

Pursuing gender equality policy, WEF suggests a four-component Closing-the-Gender-Gap Accelerator action:

- Increasing female labor force participation broadly and in selected sectors;
- Increasing the number of women in leadership positions;

- Closing gaps in wage and remuneration;
- Building parity in emerging high-demand skills and jobs (WEF, 2019, p.4).

When applied to HE&R, it means:

- Increasing the female share in HE&R in countries where parity has not been reached;
- Increasing the number of women in higher academic grades, tenure professorships and top management positions;
- Closing the GPG in HE&R;
- Building parity in STEM, industrial R&D, and digital skills.

Based on the international experience, the following range of women's empowerment measures should be implemented in HE&R:

- Raising gender awareness by providing and disseminating research evidence of how disproportionally power, resources and benefits are distributed between women and men;
- Encouraging a social dialogue between female employees, administrations of HE&R institutions, and legislators;
- Ensuring gender equality by developing and implementing legal frameworks, official and institutional policies and infrastructure;
- Zero tolerance to GBV, establishing non-discrimination control regulations, units and procedures;
- Incorporating the evaluation of progress towards gender-based goals into quality assessment procedures;
- Monitoring of the implementation of gender equality policies and of balanced resource allocation between women and men;
- Improving work/life balance and work/family compatibility by building social infrastructure and establishing flexible work schedules;
- Revising existing HR procedures (including those based on AI) and academic performance assessment criteria to avoid male bias;
- Establishing and reinforcing local, national and international female academic networks;
- Mentoring female researchers, teachers, and managers to raise their confidence, support them, and provide them with knowledge and skills relevant for career advancement;
- Deconstructing gender stereotypes, revising the history of women in science, and promoting female role models in academia; and
- Promoting female leadership in HE&R.

In order to create a synergy between sustainability, internationalization and competitiveness through women's empowerment, HE&R institutions and regulatory bodies may want to devise their own gender equality policies and align them with the global women's empowerment effort at all levels.

At the global level: deploying the UN gender-equality legal framework, SDGs, methods and tools, and implementing the gender equality policy of the Global Research Council (2016).

At the international level: implementing the gender equality policies advanced by relevant development agencies, unions, and associations such as the OECD, European Council, EU, African Union, ASEAN, Busan Partnership for Effective Development Cooperation, etc.

At the national level: facilitating social dialogue with legislators and the government and providing them with expert support to achieve:

- Ratifying relevant international agreements;
- Accessing international organizations supporting gender equality;
- Adopting antidiscrimination laws and gender-responsive regulations on the national and sectoral levels;
- Devising and implementing gender equality strategies and policies embracing gender mainstreaming and temporary special measures (e.g. gender quota, gender-responsive budgeting, women-only support programs etc.); and
- Enhancing gender-disaggregated statistics.

At the Organizational Level

- Devising gender equality policies and including them in development strategies;
- Devising annual gender equality plans to specify, quantify and monitor the measures;
- Basing managerial accounting and financial planning on gender-disaggregated figures;
- Revising internal regulations from the gender perspective, adopting new regulations or adding clauses to enhance gender balance and to prevent GBV and discrimination;
- Removing male bias from all procedures, assessment criteria, documentation and software;
- Promoting female leadership through networking and mentoring; and
- Creating infrastructure and flexible work conditions to improve work/life balance.

In the areas where they have been historically underrepresented, women have less bargaining power to change the situation, so it is crucial to involve men in gender-equitable growth. Measures have to be taken to enable women in HE&R to take their fair share of benefits and make a fair contribution to development, i.e. to *empower women.*

FUTURE RESEARCH DIRECTIONS

The interrelation between female leadership and sustainability is a potentially fruitful field of study. Further evidence-based proof of the economic rationale for women's empowerment is required. The institutional, behavioral, cognitive and cultural causes of vertical and horizontal segregation, androcentrism and GBV call for further investigation and counteraction. Biased AI algorithms and engineering solutions need urgent correction and thorough investigation, with gender balance in research teams being a substantial asset. Detecting reasons behind the GPG is important for equitable society. Research of organizational cultures and management should consistently take into account gender and gender-related findings of other disciplines. As rising educational level directly correlates with a growing gender gap in management positions and pay, the research focus in HE&R should not be on increasing women's competence but on fixing the "leaky pipeline".

CONCLUSION

As shown above, the higher the social and academic level, the more persistent gender inequality and the larger the gender pay gap. The gender hierarchy in HE&R limits women's participation in knowledge production, thus hampering development. The main causes of women's lower outcomes as compared to men's are not lack of opportunity or competence, but the increased workload from maternity, family duties and volunteering; androcentric academic culture, procedures and performance-assessment criteria; horizontal segregation with women's concentration in lower-paying specialties and occupations, and vertical segregation with women's restricted access to decision-making and funding in HE&R. Using machine learning and biased algorithms, AI tends to perpetuate gender disparity. By removing gender barriers, empowering women in HE&R and deploying the untapped potential of female intellectual capital, society can make a huge step toward a more sustainable and equitable world.

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KEY TERMS AND DEFINITIONS

Academic Gatekeeping: Control of access to the decision-making process in HE&R that tends to exclude women at higher levels.

Gender: The social dimension of the female and male sexes.

Gender Mainstreaming: The policy of integrating gender perspective into all regulatory acts, planning, monitoring, assessment procedures and resource allocation aimed at promoting women.

Glass Ceiling: Systemic culture-based barrier preventing women from advancing to the most influential and beneficial positions in organizational and social hierarchic structures.

Leaky Pipeline: Common pattern of female academic and/or managerial careers that shows decreasing representation of women at higher levels, with the negative trend typically accelerating after crossing the glass ceiling.

Male Bias: Culture-based beliefs, perceptions and attitudes that result in giving male candidates unsubstantiated preference over female candidates.

Women's Empowerment: Strategies enabling women to gain control of their own lives and to influence broader society.