FEMININE LEADERSHIP IN SCIENCE AND EDUCATION

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Abstract
Leadership is the position or function of being a leader; a governing act or court; guidance; direction; the group leader (Dictionary.com, 2006).
Following a survey of female leader- respondents, it was reached the conclusion they are likely to lead because of their inheritance, which is based on their abilities and talent. They are persuasive and have rich experience, strengths that have allowed them to be in a leading position (Astin and Leland, 1991). The leading women come from all geographical areas, from big cities to small ones, with a varied experience and past, but they all have the same common goal – to lead.
The ability of being a successful leader is often studied because it is a complex one and the success of a project or organization depends on it.
The present paper aims at identifying a series of behavioral typologies of European countries, through involvement of women in the decision-making process, in science and education, the quality of women's employment and the resources oriented to education, research and development.

Keywords
Female leadership, science, education, research and development.

JEL Classification
L66, Q18, D18, E21

Introduction
Although it cannot be exactly defined, leadership is a concept to which each of us can contribute by a formulation that could highlight the characteristics and usefulness of it. At the same time, it can be described as a multitude of attributions based on the desire for

development, innovation, with the help of a team whose members have well-defined roles, being able to collaborate in order to aim to completing a well-developed plan.

Presently, it is desired to have gender equality in terms of women's presence within the management structures in various fields - from business environment to politics, including the education area. Another aspect is remuneration: even if it is desirable to have equal level of payment, men are better paid than women, for comparable positions. Women leaders tend to worry more, to have less confidence in their own strengths, are more self-critical, but more open to feedback and self-development. They have an introspective spirit, are less impulsive, dominant, more collaborative, and more pragmatic in terms of problem solving and are more execution oriented. Women leaders are motivated to help develop and improve their teams. They focus on creating a pleasant working atmosphere and are attentive to their team's mood. Women believe in traditional values and the values of the organization they lead, they have strong ethical principles and are attentive to their personal image

Nowadays, even if women are present in the field, they do not have the same significant role in science and education, regarding the management level.

Based on the analysis of a set of 11 initial variables, the present paper identifies three complex variables, with a synthesizing function and defines patterns of behavior of European countries in terms of human development, quality of female employment, involvement of women in leadership positions in science and education, of resources oriented towards education, research and development. At the same time, a series of measures are proposed in order to correct the existing dysfunctions in these areas.

Stage of knowledge

Leadership is the factor that promotes innovation because it induces the implementation of creative ideas (Yoon, Lee, and Schniederjans, 2016). Led by the charisma of the leader, the members take the initiative and develop a sense of belonging to the group. Businesses characterized by effective leadership and strong innovation capabilities can easily cope with the ever-changing business environment because they are able to identify opportunities quickly (Chassagnon and Haned, 2015). The views of the above-mentioned authors encompass a number of characteristics of the effective leader that must be identified with the innovative environment of 21st century (Xie et al., 2018).

According to Kets de Vries, in the past, the structure on which an organization stood on, was based on stability, orientation towards nationalism, technology, a well-defined hierarchy. Currently, the author argues this organizational thinking has taken on a completely different meaning, based on internationalization, change and discontinuity, interdependence between employee and employer.

Existing literature in the field of leadership has studied the effects of different styles for this concept, the main objective being an innovative atmosphere in the team's perspective.

In the last three decades, women have been able to equal men in the labor sector, in the usual positions of workforce or in middle management. Women now make up 57% of the US labor market and 52% of all managerial roles and occupations, such as physicists or lawyers. They represent a total of 60% of the graduates of US universities and also exceed the total number of men in the category of masters and doctoral graduates.

Higher education institutions constantly face challenges of diversity management. In terms of university studies, the percentage of young women is higher than of young men in terms of probability of attending a college and having a university degree, only 20% of students in the faculties of exact sciences (IT and engineering) are women (OECD, 2017).

A study by Catalyst (2020) shows the position of women in universities in terms of attendance among teaching staff.

In Asia-Pacific area there is a large presence of women in the university environment at different levels of academic rank. Thus, in Australia women are present at a lower level of

academic rank - 46.8% of lecturer positions being held by women and only 33.9% of the above lecturer positions are held by women (lecturer and teacher). Women also occupy 54.7% of the assistant positions and 53.8% of lower positions of university assistant (Australian Government, Department of Education and Training, 2018).

In Canada, the presence of women in universities is growing. They represent 41% of the academic staff who teach and are permanently employed in the academic year 2018-2019 (Statistics Canada, 2019)

Only for the position of university professor the presence of women does not equal that of men-women, there being only 28% women university professor. The position of associate professor is represented by 44% of women, while for the position of university lecturer there is a parity of 1 to 1 with men (50%). Below this position the presence of women is 55% (Statistics Canada, 2019). Regarding the income, women earn less than men, especially in the area of academic teaching. Thus, in the academic year of 2017-2018, a female professor had an average annual income of 158,625 US dollars, while a male university professor earned 166,925 US dollars (Canadian Association of University Teachers, 2019). These values are for comparable positions.

In Europe, it has been observed that an increase in the level of academic rank increases differences between women and men. At the level of European Union (EU-28) women occupy in proportion of 41.3% university positions in 2016 (European Commission, 2019). Regarding university professors, there are only 23.7% women, lecturers - 40.5% women lecturers and university assistants - 46.4% women. Among the countries where women are under-represented at university level are the Netherlands (18.7%), Germany (19.4%), France (21.9%), Switzerland (23.3%) and Sweden (25.4%).

In terms of university management, the presence of women is even lower - only 21.7% of the university staff is represented by women (EU-28 level).

Speaking about the income level, women in British academic environment earn, on average, 15.1% less than men (University and College Union, 2019).

In the United States, women's chances of getting leadership positions are lower. Although they hold almost half of the positions (49.7%), only 39.3% of the management positions are occupied by women. As in all continents, women hold lower level academic positions. The position of assistant professor is occupied by 52.9%, 46.4% is represented by lecturers and only one third for the level of university professor in 2018 (National Center for Education Statistics, 2018).

Black population registers a low level of women's presence in academic field. The number of this category has grown in part-time area by 230% in between 1993-2013 and only by 30% in terms of full-time position. Concerning women of color and Asian or Hispanic descent, there is a low percentage, below 5% for most academic levels (teacher, lecturer, assistant) (National Center for Education Statistics, 2018).

However, there is increase in the presence of women in leadership positions among colleges and universities, from 10% to 30%. There is also increase in racial diversity, from 13% to 17% in 2011-2016 (American Council on Education, 2017).

Presenting the above statistics, one can easily observe a pattern regarding the presence of women in university environment: they are numerous in entry positions, among those who teach - university assistant and lecturer, while at the level of university professor their presence is low. Regarding management, their presence is even smaller, compared to teaching. Another aspect reported is the income level - a much lower one compared to men, for the same type of job.

Research methodology

Based on complex, multidimensional statistical analysis, the paper aims at achieving the following objectives: ● identification of complex variables in order to synthetically

characterize the activity in the field of science and education; ● defining behavioral typologies of EU and non-EU countries in terms of human development, quality of female employment, involvement of women in leadership positions in science and education, resources oriented towards education, research and development; ● proposing a set of measures in order to mitigate and / or eliminate the behavioral dysfunctions of European countries.

Concerning the research, firstly, there are analyzed a series of statistical variables defining the degree of occupation of top-management positions by women in science and education, level of training, educational and vocational training of female workforce, women's participation in labor market, gender wage imbalances, governments' concern for allocation of financial and human resources in the field of education, science and technology, research and development. The data set from which the analysis started comprises 11 variables from the above mentioned areas, their values being taken from the European Institute for Gender Equality and EUROSTAT and covers 33 European countries, member or non-member EU, for 2017 (last year for which the values of all variables were available) (Table no. 1).

Data set was reduced - by applying the Principal Component Analysis - to three complex variables, which kept a significant share of the initial informational variability. Based on multidimensional statistical investigation criteria, the Hierarchical Cluster Analysis - Wards' Method was used to form three clusters of European countries, with identification and characterization of behavioral patterns concerning female leadership in science and education, quality of female employment and the use of financial resources in education and research – development.

Table no. 1 Variables included in the analysis

Pillar	Variable name	Notation
Women in decision-making process in science and business domain	Female members of the highest decision-making body in research funding organisations (% of total)	W_Res_Fund_Org
	Female members of the highest decision-making body in academies of science (% of total)	W_Res_Fund_Org
	Women as board members in largest listed companies (% of total)	W_Comp_Board
Female employment	Female employment rate (% of females in total employment,15-64 years)	W_Empl
	Females employed in science and technology, 15-74 years (% of the total population)	W_Empl_Science
Education	Females with tertiary education, aged 15-74 (% of the total population)	W_Tertiary_Ed
	Mean instruction hours spent by participant in education and training (Hours)	W_H_Ed_Training
Gender pay discrepancies	Gender pay gap in unadjusted form (%)	GPG
GDP and expenditure in education and research-development	GDP at market prices (% of EU28 total per capita, based on million Euro, current prices)	GDP
	Government expenditure on education (% of GDP)	EXP_ED
	R&D expenditure (% of GDP).	EXP_RD

Source: created by authors

Research results

At EU level, the share of female members of the highest decision-making body in research funding organizations increased from 37% in 2017 to 38.1% in 2019 (minimum Greece 12.5%, maximum Spain 58.3%), while the share of female members of the highest decision-making body in academies of science increased from 21.6% in 2017 to 25.9% in 2019 (minimum Slovenia 7.7%, maximum Norway 57.1%). The value of "Kaiser-Meyer-Olkin Measure of Sampling Adequacy" indicator (0.719> 0.6) shows the opportunity of applying

the *Principal Component Analysis* to reduce the initial data set (Table no. 2), obtaining 3 main components that preserve 73.78% of the initial variation of the data (Table no. 3).

Table no. 2 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.719
Bartlett's Test of Sphericity	Approx. Chi-Square	225.611
	df	55
	Sig.	.000

Source: authors' own contribution, based on data provided by the European Institute for Gender Equality and EUROSTAT

Table no. 3 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.052	45.926	45.926	5.052	45.926	45.926	3.150	28.634	28.634
2	1.801	16.373	62.299	1.801	16.373	62.299	2.843	25.845	54.478
3	1.263	11.483	73.782	1.263	11.483	73.782	2.123	19.303	73.782
4	.775	7.045	80.827						
5	.682	6.199	87.025						
6	.484	4.395	91.421						
7	.321	2.922	94.343						
8	.238	2.166	96.509						
9	.221	2.005	98.515						
10	.116	1.052	99.567						
11	.048	.433	100.000						

Extraction Method: Principal Component Analysis.

Component 1 includes the variables: "W_Empl", "W_Tertiary_Ed", "W_Empl_Science" and "GPG", which characterizes women's employment quality through the education level, women's employment rate, their involvement in science and technology activities, as well as the gender pay gap. We will call this component "*Quality of feminine employment*". Component 2 groups the following four variables: "W_Res_Fund_Org", "W_Acad_Science", "W_Comp_Board" and "GDP", variables coming from the sphere of the results of economic activity and of female leadership in science and business environment. Therefore, this component will be named "*Feminine leadership in science and business environment*". Component 3 includes the variables "EXP_ED", "EXP_RD" and "W_H_Ed_Training", reflecting the governmental expenditures on education and research-development and will be named "*Financial resources in Education and RandD*" (Figures 1 and 2).
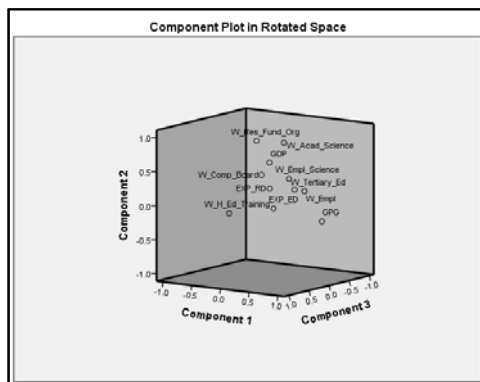

Rotated Component Matrix[a]

	Component		
	1	2	3
W_Res_Fund_Org		.910	
W_Acad_Science	.196	.872	-.184
GDP	.323	.671	.355
W_Comp_Board	.241	.494	.435
W_Empl	.851	.286	.240
W_Tertiary_Ed	.675	.287	.232
W_Empl_Science	.696	.476	.403
GPG	.833	-.228	-.221
W_H_Ed_Training			.838
EXP_ED	.599		.650
EXP_RD	.474	.334	.565

Fig. no. 1 Component Plot   **Fig. no. 2 Rotated Component Matrix**

Source: authors' own contribution, based on data provided by the European Institute for Gender Equality and EUROSTAT.

The purpose of the analysis performed further is to identify and characterize the defining behavior models of the European countries, from the perspective of the three complex components established following the Principal Component Analysis. Thus, the 11 variables included in the analysis represent the grouping criteria for 33 EU and non-EU countries through *Hierarchical Cluster Analysis*. Countries are grouped into three clusters, as follows (Table no. 4):

Table no. 4 Cluster composition

Cluster 1	Belgium, Denmark, Germany, Greece, Spain, France, Italy, Malta, Netherlands, Austria, Poland, Portugal, Slovenia, Finland, Sweden, United Kingdom
Cluster 2	Bulgaria, Czechia, Estonia, Croatia, Cyprus, Latvia, Lithuania, Hungary, Romania, Slovakia, Montenegro, North Macedonia, Serbia
Cluster 3	Ireland, Luxembourg, Iceland, Norway

Source: authors' own contribution, based on data provided by the European Institute for Gender Equality and EUROSTAT.

Countries in the first cluster are in a favorable position in terms of component 3 – financial resources in education and research-development**,** with over 2% of government spending on research and development and almost 140 de hours spent by participant in education and training. Regarding the first two complex components, the countries in this cluster are characterized by a moderate level both of the quality of the women's employment, as well as of the degree of their involvement in the decision-making process in the field of science and business - these being also the recommended directions for optimizing the activity. On average, almost 30% of women have higher education, 63% participate in the workforce and under a quarter of the employees in science and technology are women. Women earn, on average, 13.6% less than men. Thus, on average, 34.55% of all members of the highest decision-making body in research funding organisations, almost 20% of those in academies of science and over 25% of the board-members of the largest listed companies – are women. On average, the countries in this cluster have a GDP per capita close to the EU-28 average.

The second cluster includes countries with the least favorable situation of the three complex components identified. Thus, the quality of female employment is lower, just under 60% of women aged 15-64 are employed on the labor market, over a quarter of women have tertiary education, and under one fifth of employees in the science and technology sector are women. Women are to a lesser extent involved in making decision process in research, science and business. They represent nearly 30% of all members of the highest decision-making body in research funding organisations, less than 19% of those in academies of science and almost 17% of the board-members of the largest listed companies. Moreover, on average, the GDP per inhabitant represented less than half of the EU-28 average (41.65%). These countries spent the least on education and research - development - relative to GDP - of all the three clusters. The average levels of the analyzed variables indicate less than 1% of government spending on research and development and little more than 4% of government spending on education. Countries in this cluster can optimize the results of their economic activity, in an intensive way, by acting in three directions: a first direction is to increase the quality of human resources by facilitating, stimulating access to education for women, their involvement in the professional training process; the second direction is to encourage female leadership, increase the women's involvement in the decision-making process in science and business, as it is a pillar of increasing the development level; thirdly, these countries need to invest more in education and research - development, because only thus can they increase labor productivity and ensure their international competitiveness.

Countries in the third cluster are generally characterized by the most favorable level of the three complex components, especially for the variables included in the first two components. Thus, these countries are characterized by a higher quality of the female workforce, with a high average employment rate of women (over 70%), a significant share of women with tertiary education (over one third, on average), an increased degree of women's employment in science and technology (over 30%) and a lower wage gap between men and women. With respect to the 2nd component, the third cluster countries are characterized by a high participation of women in the decision-making process in science and business, women representing almost 49% of the members of the highest decision-making body in research funding organisations, almost 38% - in Academies of science and around 29% of all board-members of the largest listed companies. Also, these are countries with a high economic development level, whose GDP per capita is, on average, more than 2 times higher than the EU-28 average. Government spending on education represented 5.15% of GDP on average, a higher percentage than in the other clusters, but it is recommended that the countries in this cluster improve the time spent by women in formal and non-formal education and training and the share of government spending on research and development (Table no. 5).

Table no. 5 Cluster characterization based on hierarchical classification criteria

	Comp_1 - Feminine employment quality				Comp_2 - Feminine leadership				Comp_3 - Financial resources		
	W_Empl	W_Tertiary _Ed	W_Empl_ Science	GPG	W_Res _Fund_	W_Acad_ Science	GDP	W_Comp _Board	W_H_Ed_Tr aining	EXP_ ED	EXP_ RD
Cluster 1 - Mean	63.23	29.94	22.56	13.60	34.55	19.83	107.98	25.51	139.19	5.06	2.02
Cluster 2 - Mean	59.19	26.82	18.86	13.74	30.05	18.66	41.65	16.98	82.31	4.35	0.84
Cluster 3 - Mean	70.20	36.65	30.60	12.25	48.60	37.98	238.75	28.96	108.75	5.15	1.68

Legend:

most favorable
moderate
least favorable

Conclusions

Globally, there is tendency to promote women in as many areas as possible, both through adoption of government programs and through involvement of various organizations with specific role in facilitating women's access to labor market. (Sojo et al., 2016).

Both women and men have the right to inspire and fulfill their aspirations. People do this differently, because everyone has their own set of values to which they refer. Women realize things based more on their senses and intuition, while men are more oriented towards fulfilling the action plans. The analysis revealed three patterns of behavior in European countries, in terms of women's participation in science and education decision-making field, quality of women's employment and education, research and development-oriented resources. The first type of behavior is characterized by high level of spending on research and development and education; at the same time, there is a moderate level of quality of female employment and female leadership in science. The second type of behavior is manifested by the lowest levels of all criteria analyzed, while the third type of behavior is characterized by particularly favorable aspects in terms of women's participation in decision-making in science, but also the quality of strength feminine work.

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