Characterization of leadership styles, with a gender approach: a study with final-year students from an Engineering School in Chile

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Investigating Gender-Based Differences in Leadership Styles among Final-Year Students in an Engineering Faculty: A Characterization Study

Abstract

In Chile, women make up the majority of higher education students, yet only 20% of engineering graduates are women, according to OECD data. This general masculinization affects not only gender distribution in engineering, but also women's opportunities in attaining leadership roles. Limited access to higher-level positions having greater decision-making powers and better salaries shows ongoing vertical gender segregation in various industries. Leadership style is defined as the blend of traits, skills, and behaviors that leaders exhibit when interacting with their team. Given that the dominant leadership model in organizations is male- oriented, studies have shown the benefits of gender equality in leadership positions where femaleleadership characteristics are crucial. Future engineers must be equipped to assume leadership roles, which can be achieved through their education. This present investigation aims to study leadership characteristics of final-year students in the Industrial Engineering program in the engineering faculty of a prominent Chilean university. The goal is to identify various leadership styles in students and compare differencesand similarities based on gender. A questionnaire, with Likert-scale responses, was used to gather data on leadership styles and skills. The results allow for an analysis of various leadership styles present in final-year Industrial Engineering students, highlighting differences and similarities in the sample by gender. Based on these findings, recommendations are made to foster desired leadership styles informative years, aligning with current organizational demands for decision-making positions.

Keywords: Female leadership, Leadership styles, Gender, industrial engineering

Introduction

Women now have better access to higher education compared to previous generations. A study shows that women's participation in higher education in recent years has surpassed that of men [1]. However, this increase in enrollment by women in higher education does not lead to greater women representation in leadership and decision-making positions. For example, in the field of education, a study by Riquelme [2], found that the number of woman rectors at Chilean universities belonging to the Consortium of State Universities of Chile (CUECH, in its Spanish acronym) is only 16.7%. According to the data, these leadership positions are highly dominated by men, meaning there is an overrepresentation of males in said positions. The presence of a gender surpassing 60% in a position is considered as overrepresentation, whereas the presence of a gender with less than 40% participation is considered as underrepresentation [3]. The concentration of women and men in occupational leadership positions is referred to as "vertical gender segregation", which refers to the greater or lesser opportunity for individuals to reach higher hierarchical positions, with men having a greater chance of accessing these senior positions. The engineering sector has a significant gender imbalance, with a higher concentration of men in leadership positions.

This study aims to analyze the leadership styles of senior students in the Faculty of Engineering

of a Chilean university, and to compare these styles across genders, focusing on understanding how leadership styles impact the ability of students to obtain positions of responsibility. The goal of this study is to examine gender differences in leadership styles as measured by the tool used, and to analyze results based on different leadership dimensions. Aiming to gather information that will inform the development of student leadership training programs, with an emphasis on what is currently sought by companies. The study begins with a review of the literature on leadership styles, with a focus on the characteristics associated with a feminine leadership style, which are believed to be applicable by both men and women. The study goes on to look into the different existing tools for evaluating leadership styles, where an instrument is selected with questions on a Likert scale that allow the identification of three leadership styles: Advisory, Authoritarian and Dictatorial [4]. A quantitative study is applied that allows to specifically examine the leadership styles of male and female students in the faculty. The study was able to provide dimension-wise insights into the leadership characteristics of the surveyed student group, allowing for the development of recommendations for engineering leadership training.

Related works/bibliographic review

On leadership in engineering education

While the OECD (2015) [5] reports that only 20% of engineering graduates are women, the United Nations 2030 agenda includes gender equality as one of its sustainable development goals, specifically the SDG 5, which aims to achieve equal rights and opportunities for women and girls.

As mentioned earlier, the low representation of women in engineering remains a concern, as their participation in STEM fields (Science, Technology, Engineering, and Mathematics) hovers around 20%. This figure is even lower in specific engineering specialties, as reported by Zapata and Truyol (2022) [6]. According to the 2019 European Union report "She Figures", only 15% of women in STEM occupy high-ranking positions, compared to 22% of those present in higher education [7]. This leads to an unequal representation of genders in a highly relevant space, as are Universities, where the education of future professionals takes place.

A 2005 study conducted a bibliographical review on the entry and retention of women in STEM careers [8]. The study identifies several factors contributing to the low representation of women in STEM fields, including a lack of female role models, which conveys the message that women are not inclined or capable of pursuing careers in science or engineering. Moreover, the study highlights that simply increasing the number of women in these disciplines is insufficient. This is because many women in STEM have had to conform to a more masculine model to fit in and succeed.

Camps [9], also addresses this issue in her research, which involved interviewing women in senior management. She found that some interviewees sought to distance themselves from feminine traits, as they to work with men and are comfortable in male-dominated environments. Moreover, these women were concerned that embracing a more feminine leadership style could harm their careers. Some of these women even acknowledged over-compensating by adapting too much to masculine environments. In a male-dominated culture, it is taken for granted that the

masculine perspective is considered universal.

Regarding leadership styles

The literature recognizes various types of leadership styles. From a contemporary, relational perspective, we have the following types of leadership: Transactional, transformational and transcendental [10]. In a leadership analysis made by Cáceres, Sachicola, and Hinojo (2015) [11], it was found that various authors associate transformational or interactive leadership with a feminine style, while a transactional leadership with a masculine style."

Bass, cited in Contreras and Barbosa, 2013[12], defines transactional leadership as being based on traditional models and centered on an exchange or transaction. The leader wields their power by rewarding or punishing employees according to their performance, staying within their designated responsibilities with a focus on maintaining standard operations within the organization, without deviating into strategic development [12]. This leadership style has predominated, leading many women to adopt it without exploring alternative approaches [11].

Transformational leadership encompasses a range of qualities, traits, and characteristics that align with the female gender stereotype, such as a strong inclination towards social and communicative relationships that they tend to exhibit. Studies on this leadership style suggest that it leads to better organizational outcomes due to the leaders' charisma, inspiration, and focus on the organization's interests [11]. It is also seen as more aligned with the current change-oriented perspective of organizations [12].

According to Bass in [12], “leadership or management styles are the various ways leaders behave and interact with others to carry out their duties as leaders." Koontz, Weihrich, and Cannice [13] state that women's leadership style is often more democratic or participatory in nature. Women leaders are more likely to involve others in decision-making, share power and information, and boost their followers' self-esteem. They lead through inclusion, using their charisma, experience, personal connections, and interpersonal skills to influence others. Their actions are meant to inspire others to align their interests with those of the organization. According to the authors Paz, Pinto, Cantillo, Garcia, and Suarez in [4], their scientific article "Female Leadership: A management style at Guajira University”, defines four styles of leadership, namely:

(1) **Participatory:** A leadership style that delegates most of its authority to the team. However, the leader continues as team leader. A participative leader, as described by theauthor, is one where team members see themselves as equal to the leader in terms of providing input and ideas.

(2) **Authoritarian:** One of the notable shortcomings of this type of leadership is the inabilityto assess the strengths and weaknesses of their work team, hindering their ability to leverage their insights into planning and decision-making. The leader takes charge of decision-making, insists on compliance and keeps a close watch on their collaborators to ensure they follow guidelines and fulfill job duties.

(3) **Advisory:** This leadership style involves taking into account the input and opinions of team

members when making decisions. This means the leader consults their team beforemaking significant decisions, as those decisions will impact their team.

(4) **Dictatorial:** The leader is controlling and abusive, keeping decision-making power to themselves, setting unrealistic expectations, using harsh criticism and punishment, and rejecting any challenges to their authority.

Whilst specific traits, relating to performance, can aid a leader in their leadership role, there are also technical skills which refer to a person's abilities in successfully executing certain processes and which are more important at operational and professional positions. There are also skills relating to human relations, understood as the ability to work effectively with other people as a team. Finally, there are conceptual skills, encompassing the complexity of the company as a whole and how personal influence is articulated within the organization [4].

Leadership with a gender perspective

Many studies have been conducted to examine the existence of gender differences in leadership styles. Gender stereotypes persist in corporate structures and are reflected in related concepts such as vertical segregation, the glass ceiling, and the sticky floor, among others [11]. These stereotypes address ongoing issues in companies that hinder the advancement of women into leadership positions.

Incorporating women at various management levels is crucial, as noted by Tatiana Camps in her book "Leading from the Feminine" [9]. Women's contribution to sustainability comes from their leadership style that prioritizes and fosters peace, i.e., leading from the feminine. Something which is defined as an approach to energizing, planning and directing the organization that emphasizes emotional intelligence, typically associated with women through gender stereotypes, seamlessly blending rational thinking with the more humane aspects of the organization's members. The author views Leadership from the Feminine as traits that are traditionally associated with women but not limited to them, they can therefore be developed by anyone, regardless of gender.

Regarding study aims

The goal of the study was to examine leadership traits as seen in senior Industrial Engineering students and to compare and contrast any differences or similarities by gender. Thisprovided insight into the skills and training the student body had received during their engineering formation. The tool to be employed will enable the identification of four different leadership styles and an evaluation based on skill dimensions. With the obtained data, conclusions and recommendations can be made that may enhance much sought-after leadership styles in companies and to promote synergies in male and female leadership styles.

Methodology

The study was a quantitative research conducted on senior Industrial Engineering students atthe Faculty of Engineering of a reputable university. Final year students were assessed as it is

believed that their university education has significantly influenced the development of their skillsand leadership style. The primary focus of the study was to identify the leadership styles of the participants and to analyze any gender-based similarities and differences in results.
The tool used was an adaptation of the 21-question instrument, as developed in the Female Leadership study: A Management Style, from the University of La Guajira in Colombia [4]. These modifications had an impact on the wording of the questions so that they would better fit the researchcontext, that is, the University environment, but they did not change the meaning of the questions. The self-administrated questionnaire was distributed online, and voluntarily completed by students. The instrument used a Likert scale, from 1 to 5, with 1 being Strongly Disagree and 5 being StronglyAgree.

In relation to the size of the samples studied, from a universe of 182 students, there is an accidental sample of 53 valid answers, with a confidence level of 95% and a sample margin of error amounting to 11%. Cronbach's Alpha corresponds to 0.658. Regarding sample characterization and understanding male and female as a gender category, it is found that 81.13% of the sample identifies with the male gender and 61.11% of the sample being aged between 21 to 25 years old.

Research limitations were related to data gathering, as it was found difficult to achieve greater student participation given the online distribution format. Checks were made using the Kolmogorov-Smirnov test, finding that the distribution did not follow a normal distribution, so non-parametric statistics, Mann Whitney test, Spearman correlations and, finally, correlation analyzes for independent samples were used. All tests used the SPSS statistical software.

Data analysis and results

Collected data descriptions are initially presented. Inferential analyzes are also presented. The dimensions addressed by the instrument correspond to technical skills, human skills, conceptual skills, participative, authoritarian, consultative and dictatorial leadership styles. The results obtained for each of them are shown in Table 1.

Given the data obtained for this sample, it is possible to see that the predominant leadership styles are participatory and consultative, as seen in Table 1. In addition, the same table shows that for human skills and the consultative leadership style, the averages were higher for the male gender in the sample. With regard to technical and conceptual skills and authoritarian and dictatorial leadership styles, the averages were higher for females in the sample.

In order to further probe these results, the Mann-Whitney test was carried out, aiming to compare the results obtained for the male sample and the female sample in the dimensions of interest, allowing us to state that there are statistically significant differences only for the case of the authoritarian leadership style (Mm =2.235, Mf=2.930, Z=-2.338, p=0.019) and for the dictatorial leadership style (Mm=2.998, Mf=3.670, Z=-2.357, p=0.018). As previously mentioned, in both cases, the average for these leadership styles is higher in the case of females.

Table 1. Descriptive by gender

			Minimum	Maximum	Mean	Std. Deviation
MaleN=43	Skills	Techniques	3.30	5.00	4.4000	.47909
		Human	2.30	5.00	4.0302	.66280
		Conceptual	3.50	5.00	4.7209	.38270
	Leadership styles	Participatory	3.30	5.00	4.4860	.46934
		Authoritarian	1.00	3.70	2.2349	.85687
		Advisory	3.30	5.00	4.5837	.44236
		Dictatorial	1.00	4.70	2.9977	.90855
Female N=10	Skills	Techniques	3.30	5.00	4.4600	.53996
		Human	3.30	4.50	3.9800	.42635
		Conceptual	4.50	5.00	4.9000	.21082
	Leadership styles	Participatory	4.30	5.00	4.6400	.26331
		Authoritarian	2.00	3.70	2.9300	.61110
		Advisory	3.30	5.00	4.5000	.58310
		Dictatorial	3.00	4.30	3.6700	.44234

In order to analyze the relationships between the variables of interest, Table 2 presents the results for the Spearman correlation test for the whole sample in terms of leadership styles. It can be seen that there is a strong and statistically significant correlation between the authoritarian and dictatorial leadership style. Likewise, there is a statistically significant, but with low correlation between consultative and participative leadership styles, and no significant correlation with other leadership styles. This leadership style correlation pattern is maintained in the male sample (consultative-participative: rho=0.359, p=0.007; authoritarian-dictatorial: rho=0.708, p<0.0001).

For the female sample, those leadership styles having a highly significant statistical correlation are the consultative and dictatorial styles (rho= 0.709, p=0.022), while there are no statistically significant correlations seen in the other cases. With regards to correlations between skills and between types of skills and types of leadership,differences can be reported between male and female samples. Regarding the female sample, mention can be made of the statistically significant correlations between technical skills and consultative leadership style (rho=0.660, p= 0.038) and between human and conceptual skills (rho= 0.676, p=0.032). The male sample has significantly low statistical correlations between human and technical skills (rho=0.421, p=0.005); between human and conceptual skills (rho=0.302, p=0.049) and conceptual skills and participative leadership style (rho=0.372, p=0.014).

Results Discussion

The previous section shows that the most frequent leadership styles in the studied sample are consultative and participative. In addition, although authoritarian and dictatorial leadership styles are not the most prevalent in the sample studied, females present higher averages in these cases. This may be due to the fact that, historically, it has been the male gender that has mostly led organizations under a traditional leadership style associated with the transactional model. This leads to the fact that people of the female gender perceive it as necessary to adopt this style of

leadership, even during their university education, as it is in this case. Similar results have been found in the field of business field [9].

Table 2. Spearman correlations. N=53

		Participatory	Authoritarian	Advisory	Dictatorial
Participatory	CorrelationCoefficient	1.000	-.019	.364(**)	.172
	Sig. (2-tailed)	.	.891	.007	.217
	N	53	53	53	53
Authoritarian	CorrelationCoefficient	-.019	1.000	-.011	.742(**)
	Sig. (2-tailed)	.891	.	.940	.000
	N	53	53	53	53
Advisory	CorrelationCoefficient	.364(**)	-.011	1.000	.072
	Sig. (2-tailed)	.007	.940	.	.611
	N	53	53	53	53
Dictatorial	CorrelationCoefficient	.172	.742(**)	.072	1.000
	Sig. (2-tailed)	.217	.000	.611	.
	N	53	53	53	53

** Correlation is significant at the 0.01 level (2-tailed).

Regarding total sample correlations, there is a high correlation between the consultative leadership style and the participative one, while a similar correlation is seen between the dictatorial one with the authoritarian one. The aforementioned finding seems reasonable given the characteristics of each of the leadership styles. This same correlation result is repeated when analyzing those who identify themselves as male. However, it can be seen that, when analyzing the female gender, there is a high correlation between the dictatorial and consultative leadership style. This leads to the conclusion that, for this sample, those who have a predominantly dictatorial style also have characteristics relating to a consultative style. This leads us to reflect that perhaps those who identify with the female gender do not necessarily adopt a single leadership style, being able to adapt or combine different style characteristics, which may be considered as opposing styles. These types of combination do not appear in the male study sample.

Finally, when analyzing skills correlations, two high correlations are seen, yet only for the female sample. The first one is seen between skills relating to human relations and conceptual skills, while the second is between consultative leadership style and technical skills. The first case considers both skills within a higher range of decision-making, where teamwork, together with one's own awareness as influencer within the organization, are closely linked. The second case considers technical skills which are present at a lower or operational rank within the organization, and they are therefore not faced with definitive decision-making, probably adopting a more consultative leadership style, which lists among its characteristics that of not making decisions without first consulting thers.

Conclusions, future directions

The present work was geared to study leadership styles in senior students of the Industrial Engineering program of an Engineering Faculty of an important Chilean university. The objective was to identify the different leadership styles students exhibit, in order to ascertain whether or not there are any gender differences and similarities.

Although Cáceres, Sachicola and Hinojo [11] show that different authors associate transformational or interactive leadership to a feminine style, and a transactional leadership to a masculine style, the results of the study regarding leadership styles indicate some different characteristics. As previously presented in the results, females scored higher averages in authoritarian and dictatorial styles, which may be associated with a more transactional style. This may be due to the search for reference models in leadership positions, and associating these reference models as being appropriate, or optimal, in reaching management positions within an organization. However, the prevalent leadership style in study participants is that of a consultative leadership. Furthermore, it was found that the female sample showed a higher correlation between consultative and dictatorial leadership styles, which may be an indication of the need women have to adapt to an environment dominated by men and to a search for role models that only yields male leaderships. Regarding correlations, there is evidence of coherence between skills and the leadership profile,seen more strongly in female respondents. In addition, considering that respondents do not haveformal professional experience as engineers, they find themselves at a more operational management level and, therefore, tend to consult on their decisions more frequently, associated with the consultative leadership profile. It should be considered that the results obtained may be influenced by the size of the sample obtained. To generalize these findings, it is recommendable to expand the sample.

This study allows us to have a vision of the leadership styles that characterize students who are about to graduate from Industrial Engineering. In particular, the need to make explicit, within their training program, leadership references based on what organizations require in today's world of work. This means being able to train and generate skills that strengthen areasassociated with profiles most in demand, such as consultative and participatory skills.

References

[1] M. Lorenzo Delgado, T. Sola Martínez, and M. P. Cáceres Rrche, "El liderazgo femenino en los cargos directivos: un estudio longitudinal en la Universidad de Granada (1990-2005)," *Educ. y Educ.*, vol. 10, no. 2, pp. 177–194, 2007.

[2] S. Riquelme, "MUJERES EN ESPACIOS DE DECISIÓN. ESCENARIO ACTUAL EN LAS UNIVERSIDADES ESTATALES CHILENAS," *Gob. y Adm. Pública*, no. 2, pp. 40–61, 2021, doi: 10.29393/gp2-3mesr10003.

[3] A. Buquet, J. A. Cooper, A. Mingo, and H. Moreno, "Intrusas en la universidad," *Perfiles Educativos*, vol. 35, no. 141. pp. 196–199, 2013, doi: 10.1016/S0185-2698(13)71843-9.

[4] P. Marcano, P. Aragón, C. Campo, G. Guiliany, and S. Barros, "Female leadership: A management style at the University of La Guajira Contenido," *Rev. Espac.*, vol. 40, 2019.

[5] M. Oliveros, E. Cabrera, B. Valdez, and M. Schorr, "La motivación de las mujeres por las carreras de ingeniería y tecnología," *Entreciencias Diálogos en la Soc. del Conoc.*, vol. 4, no. 9, pp. 89–96, 2016, doi: 10.21933/j.edsc.2016.09.157.

[6] C. Zapata and M. Elena Truyol, “Factors identifying commitment to gender equality in a School of Engineering,” *2022 ASEE Annu. Conf. Expo.*, p. 17, Aug. 2022.
[7] T. RAbAzAs RomeRo, A. Resa Ocio, and T. Rabazas Romero, “Organizaciones y políticas supranacionales: una mirada desde la educación superior y la igualdad de género Supranational organizations and policies: perspectives from higher education and gender equality,” *Rev. Española Educ. Comp. | núm*, vol. 37, pp. 281–298, doi: 10.5944/reec.37.2021.27793.
[8] J. C. Blickenstaff, “Women and science careers: Leaky pipeline or gender filter?,” *Gend. Educ.*, vol. 17, no. 4, pp. 369–386, Oct. 2005, doi: 10.1080/09540250500145072.
[9] T. Camps, *Liderar desde lo femenino*, 1.st ed. Santiago, Chile: Urano, 2021.
[10] A. F. Jiménez-López, D. Gómez Aguirre, J. Rendón Otálvaro, and S. P. Peláez Arcila, “Revisión del liderazgo, sus estilos y modelos de medición en la última década,” *RHS-Revista Humanismo y Soc.*, vol. 8, no. 1, pp. 81–98, Jul. 2020, doi: 10.22209/rhs.v8n1a06.
[11] M. Caceres, A. Sachicola, and M. Hinojo, “Análisis del liderazgo femenino y poder académico en el contexto universitario español,” *Eurepean Sci. J.*, vol. 11, no. 2, pp. 296–314, 2015.
[12] F. Contreras Torres and D. Barbosa Ramírez, “Del liderazgo transaccional al liderazgo transformacional: implicaciones para el cambio organizacional,” *Rev. Virtual Univ. Católica del Norte*, vol. 2, no. 39, pp. 152–164, 2013.
[13] Weihrich, H. Koontz , and M. Cannice, Administración. Una perspectiva global y empresarial, 14.th ed. México: McGraw-Hill Education, 2012.