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Development of Complex Thinking in Entrepreneurship Training: A Gender Approach

Desarrollo del pensamiento complejo en la formación empresarial: un enfoque de género

Patricia Esther Alonso-Galicia [a]*, José Carlos Vázquez-Parra[b], Isolda Margarita Castillo-Martínez[c], María Soledad Ramírez-Montoya[d]

[a] *Eugenio Garza Laguera Institute of Entrepreneurship and Business School, Tecnológico de Monterrey, Monterrey, México.*
https://orcid.org/0000-0001-7289-163X pealonsog@tec.mx
[b] *Institute for the Future of Education and School of Humanities and Education, Tecnológico de Monterrey, Monterrey, México.*
https://orcid.org/0000-0001-9197-7826 jcvazquezp@tec.mx
[c] *School of Humanities and Education, Tecnológico de Monterrey, Monterrey, México.*
https://orcid.org/0000-0003-3968-5775 isoldamcm@hotmail.com
[d] *Institute for the Future of Education and EGADE Business School, Tecnológico de Monterrey, Monterrey, México.*
https://orcid.org/0000-0002-1274-706X solramirez@tec.mx

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ABSTRACT

This article aims to approach students' perception of mastery of the reasoning-for-complexity competency and its sub-competencies (scientific, systemic, and critical thinking) in a sample group at a Latin American university. The intention was to identify whether there are statistically significant differences in a population of men and women in a training program in entrepreneurship, assessing whether gender could be a factor to consider by educational institutions offering these specialties. The present exploratory study applies the validated E-Complexity instrument to measure the perception of a convenience sample of 116 students from a private university in Mexico. Statistically, the overall mean and the means for each item were calculated for the students' perception of their mastery of the reasoning-for-complexity competency. From the results, we can confirm that no statistically significant evidence demonstrates differences between men and women in their perceived mastery of the reasoning-for-complexity competency in general. However, analyzing the results by sub-competencies shows that women tend to have a higher perception than their male counterparts. Thus, this article shows the need to develop environments beyond academia and theory, guaranteeing an actual follow-through to equality promoted within educational institutions.

Palabras Clave
Educación Superior, innovación educativa, competencia de pensamiento complejo, formación en emprendimiento, brecha de género

RESUMEN

El objetivo de este artículo es aproximarse a la percepción de los estudiantes sobre el dominio de la competencia razonamiento para la complejidad y sus subcompetencias (pensamiento científico, sistémico y crítico) en un grupo muestra de una universidad latinoamericana. La intención fue identificar si existen diferencias estadísticamente significativas en una población de hombres y mujeres en un programa de formación en emprendimiento, evaluando si el género podría ser un factor a considerar por las instituciones educativas que ofrecen estas especialidades. El presente estudio exploratorio se basa en la aplicación del instrumento validado E-Complejidad para medir la percepción de una muestra de conveniencia de 116 estudiantes de una universidad privada en México. Estadísticamente, se calculó la media general y las medias de cada ítem para la percepción de los estudiantes sobre su dominio de la competencia razonamiento para la complejidad. A partir de los resultados, podemos confirmar que no existen evidencias estadísticamente significativas que demuestren diferencias entre hombres y mujeres en sus niveles percibidos de dominio de la competencia de razonamiento complejo en general. Sin embargo, el análisis de los resultados por subcompetencias muestra una tendencia de las mujeres a tener una percepción superior a la de sus homólogos masculinos. Así, este artículo muestra la necesidad de desarrollar entornos más allá de lo académico y lo teórico, que garanticen un seguimiento real de la noción de igualdad promovida en las instituciones educativas.

(*) Autor de correspondencia / Corresponding author

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1. Introduction

One of the most significant challenges facing entrepreneurship training is that, unlike other areas of study, it must promote acquiring new knowledge of the administrative and business discipline and developing skills that provide the future entrepreneur with the ability to generate, implement, and develop and consolidate a proposal (Cheung & Wong, 2018). Therefore, it is necessary that the students, during their training process, acquire competencies that facilitate facing an uncertain world, which requires reasoning for complexity, a skill that universities with entrepreneurial training programs consider with greater attention (Suárez-Brito et al., 2024; Wishnu et al., 2020).

Complex thinking or reasoning is the ability of individuals to integrate the knowledge they possess to analyze and synthesize information that allows them to solve the problems they face. This type of reasoning includes quantitative, qualitative, analogical, contextual, imaginative, combinatorial, and creative analysis skills. The aim is to enable people to understand their reality, considering the elements and factors involved in any phenomenon dynamically, allowing them to make comprehensive proposals (Castillo-Martínez et al., 2023Vázquez-Parra et al., 2023).

However, although the value of this competency is recognized, and all students are expected to develop these skills and knowledge similarly, entrepreneurship training programs are only sometimes designed to promote equity and inclusion. Unfortunately, most entrepreneurship training programs universities offer are based on developing skills and competencies related to entrepreneurship without considering individuals and their differences (Alvarez et al., 2021). In this sense, evidence suggests that women are underrepresented as participants and collaborators in many of these training programs, which is reflected in the fact that, according to Granados (2020), entrepreneurial education and training programs end up having less impact on developing competencies in women than in their male peers, which, in the long run, impacts their subsequent entrepreneurship process. Additionally, in some Latin American countries, such as Mexico, various barriers to practical entrepreneurship training for women are perceived, including cultural and social biases, the predominance of male instructors, and the greater use of male role models in the content delivered (Alonso-Galicia & Silveyra-León, 2022; Sanabria-Z et al., 2024).

In Latin America, the issue goes beyond education and extends to a noticeable disparity in entrepreneurship between genders. The gender gap is evident in the region, impacting not only the involvement of women in initiating businesses but also their chances of success once they embark on entrepreneurial ventures (Baeza & Lamadrid, 2019). Despite entrepreneurship being a crucial catalyst for economic growth and innovation in many Latin American nations, women encounter more barriers and difficulties than men. These challenges include limited access to financial resources, difficulties in balancing work responsibilities with family life, a lack of robust professional and business support networks, and the pervasive discrimination and unequal opportunities faced solely due to their gender (Al-Qadasi et al., 2023).

In this sense, it is important to develop studies that are not limited to evaluating the development of skills or knowledge among the students of these training programs but also consider the importance of training having a similar impact on all students, regardless of their personal characteristics or gender. The perception of students about their potential and their competencies has an evident influence on the vision they develop about their job opportunities, which, from the universities, must be promoted within a framework of equity (Bian et al., 2023).

Thus, this study aims to approach the students' perception of mastery of the reasoning-for-complexity competency and its sub-competencies (scientific, systemic, and critical thinking) in a sample group of students from a Latin American university. The intention is to identify statistically significant differences between a population of men and women in a training program in entrepreneurship, assessing whether gender could be a factor to be considered by educational institutions offering these specialties. To achieve this goal in the present exploratory study, we applied a validated instrument to measure the university students' perception of their mastery of reasoning-for-complexity to have statistically significant data to support the hypothesis that there is a gender gap in developing this competency and its sub-competencies in students of a training program in entrepreneurship.

2. Theoretical Framework

2.1. Complex thinking and entrepreneurial training

For Morin (1990), the competency of complex thinking is extremely valuable for future professionals since it enables them to face the challenges of the uncertain and volatile reality they will experience in their professional development. According to Tobón and Luna (2021), the capacity of future professionals to make decisions and

solve complex problems is fundamental in a globalized, interconnected, and constantly changing world. Thus, the competency of complex thinking considers mastering three types of thinking: scientific thinking, critical thinking, and systemic thinking (Tecnologico de Monterrey, 2019). This article's instrument dimensions applied and analyzed are based on this concept. Still, it is important to point out that complex reasoning currently considers a fourth type of subcompetence: innovative thinking (Ramírez-Montoya et al., 2024), which has now become the theoretical foundation for the study of complex thinking by the authors of this research.

Scientific thinking is the ability of an individual to solve problems and challenges using objective, validated, and standardized methodologies, obtaining relevant evidence, and seeking the highest possible level of certainty about the results of their analyses and decisions (Koerber & Osterhaus, 2019). Scientific reasoning pays special attention to adopting the scientific method as a sufficient and reliable process to understand phenomena and solve the challenges of uncertain reality (Suryansyah et al., 2021). *Critical thinking* focuses primarily on the ability of people to question and rethink their knowledge of their environment, evaluate the information acquired, and generate additional classifications, reflections, and syntheses (Cui et al., 2021). For these individuals, it is relevant to develop logical approaches to rethink what they know to generate innovative, efficient, and creative proposals (Tecnologico de Monterrey, 2019). *Innovative thinking* involves successfully applying creative capacity (Passig & Cohen, 2014). Finally, *systemic thinking* allows individuals to perceive phenomena integrally, identifying the elements that comprise them while recognizing their dynamics, interactions, and impact (Jaaron & Backhouse, 2018). Thus, developing systems thinking sub-competencies allows approaching analyses with a broad, interconnected vision and considers all the parts comprising a problem (Silva & Iturra, 2021).

Due to the above, educational institutions see the relevance of developing complex thinking skills in their classrooms, considering that this competence provides relevant cognitive tools for their students to face the challenges of their professional future. In this sense, it is possible to find varied studies that show this relationship between the formation of complex thought and issues associated with contemporary work demands. Fidalgo-Blanco et al. (2022) reflect on education 4.0 in complex environments, especially as learning about the Covid-19 pandemic. García-Peñalvo et al. (2024) analyze the relationship between the use of Artificial Intelligence in the training processes of universities and the need to develop critical thinking in students. These two studies are just a couple of examples, but they show this latent need to promote complex thinking as a valuable skill for lifelong learning.

As for entrepreneurship training, this has also shown the need to evolve as time goes by. The more flexible and adaptable the entrepreneur is, the more significant opportunities his projects will have. For Fiore et al. (2019), future entrepreneurs must work in increasingly multidisciplinary teams; this challenges individuals with specific skills, focusing only on one field of study or failing to integrate complex knowledge. Handayani and Naibaho (2019) point out this same need for flexibility and foresee that the arrival and development of Industry 4.0 bring an urgent need for new entrepreneurs with the capacity for adaptability and understanding of increasingly uncertain environments. In this sense, Meurer et al. (2022) consider that the competency of complex thinking and its sub-competencies adhere to the needs and characteristics that should be promoted among entrepreneurship students, especially when responding to uncertain and changing situations such as those currently experienced in the world. Ratten (2020), Ratten and Jones (2021), and García-Peñalvo et al. (2020) consider that the Covid-19 crisis put both companies and higher education institutions to the test, demonstrating, more than ever, the importance of developing complex thinking skills in all their students, including those in entrepreneurship training programs.

Despite the necessity of nurturing complex thinking in entrepreneurial processes, the intersection of this relationship still needs to be explored, mainly in academic circles. This is evident in a bibliometric study conducted by Vázquez-Parra, Cruz-Sandoval et al. (2022), where they could only identify 33 articles that connect complex thinking and entrepreneurship. Less than a third of these articles focus on education and professional training. Consequently, this study presents a compelling opportunity for valuable academic and practical contributions, especially from a gender perspective, as it seeks to enhance our understanding of this relationship.

2.2. Training in entrepreneurship with a gender perspective

Modern universities are more focused on maintaining their cutting-edge status and academic excellence. Nowadays, they also grapple with challenges related to their influence on individuals, regional progress, and the assimilation of new cultural norms (Gutiérrez Vargas, 2022). Consequently, an emerging trend is for universities to embrace inclusive viewpoints, like education, focusing on diversity and gender. By doing so, these institutions

aim to challenge and reshape the unequal power dynamics in their respective social contexts (Vázquez-Parras, Amézquita-Zamora, et al., 2022).

In this sense, the institutions that declare themselves with a gender perspective make clear efforts to trigger the critical analysis of inequalities and the promotion of equity both in their classrooms and in the academic reflection that takes place in their spaces, seeking to promote awareness and awareness about inequalities, incorporating content and promoting the participation and leadership of their community of women(Vázquez-Parras & Ortiz-Meillón, 2018). The university gender perspective seeks to promote safe spaces open to dialogue, where it is possible to discuss and reflect from a perspective of equality for the promotion of more egalitarian and just societies (Baeza & Lamadrid, 2019).

As part of these efforts, the need to carry out studies that relate disciplinary training with gender arises, since although in some disciplinary programs women have already become the majority in the classroom, this has not been able to translate into work environments. In the specific case of entrepreneurship, according to the Global Entrepreneurship Monitor (2021), although women are increasingly present in university academic programs in Latin America, their entrepreneurship rates continue to be the lowest compared to men in the region.

It is estimated that, in the United States, only 11% of high-level companies are founded by women, and only 7% of venture capital ends up in organizations led by women. In addition, the Covid-19 pandemic has amplified the social and economic cost of inequalities between men and women, increasing the meaning and relevance of studies that respond to correct these inequalities through education. It is estimated that taking action to improve gender equality could add $13 trillion to the world's Gross Domestic Product (GDP) by 2030 (McKinsey & Company, 2021).

According to Entrialgo and Iglesias (2018) and Langowitz and Minniti (2007), a lack of female entrepreneurial role models limits the inclusion and development of female entrepreneurship. The almost null visibility of female voices in the business field was thwarted considering the needs of women at the time of entrepreneurship, even during their training. Therefore, as noted above, although women make up the majority of students, they are underrepresented in university entrepreneurship training programs (Menzies & Tatroff, 2006; Peterson & Limbu, 2010). Evidence suggests that women are poorly represented as participants and collaborators in many of these programs, which is reflected in the absence of gendered metrics, the majority delivery of male content, the use of language and images of entrepreneurship that exclude women, and limited knowledge about equity, diversity, and inclusion among program administrators (Elliott et al. 2020; Elliot et al., 2021; Liu et al., 2020; Nowinski et al., 2019). All this establishes invisible barriers that limit young female students from their training, impacting their recruitment and proposal generation by putting them in an environment that does not adapt to their needs and renders an unattractive and intimidating business and organizational culture (Ferreras et al., 2021).

Although various economies and governments invest heavily in entrepreneurship education and training, according to Orsen et al. (2019), no coordinated effort is responsible for promoting the inclusion of a gender perspective in this field. Thus, according to Gabriela Ramos (2018), from the OECD, entrepreneurial education and training programs have less impact on women than men, which, in the long run, impacts their subsequent entrepreneurial process.

For the above reasons, it is increasingly necessary to pay more attention to the relationship between entrepreneurial training and concrete actions to promote the gender perspective in all processes, including the equal development of competencies and skills established in the graduate profile. Thus, considering the relevance of the complex thinking competency in training new entrepreneurs, this article aims to identify whether there are statistically significant differences in the perceived level of achievement of this competency and its sub-competencies between a population of male and female students in an entrepreneurial training program. The intention is to understand whether the limitations to female entrepreneurship are formative or whether attention should be paid to other elements, such as the environment. Thus, the following research hypothesis is proposed:

H1: There is significant evidence of a gender gap in developing complex thinking competency and its sub-competencies among students of an entrepreneurial training program.

3. Methodology

3.1. Participants and procedure

A convenience sample of 116 students from a private university in Mexico studying entrepreneurship-related subjects included 55 men, 59 women, and 2 people who did not want to divulge their gender. This exploratory

study was conducted between August and December 2021 with these students in their first to ninth semesters. A self-administered questionnaire through Google Forms was applied for the students to answer voluntarily.

As it is an implementation in students, this study was regulated by the R4C research group, with the support of the Writing Lab of the Tecnologico de Monterrey. Being an exploratory study, it will be required that the sample should be at most 4 groups of students (120), with the commitment to be able to expand the sample from these first results.

3.2. Instrument

The eComplexity Likert scale questionnaire applied had 25 items distributed in three dimensions: systems thinking (items 1 to 9), scientific thinking (items 10 to 17), and critical thinking (items 18 to 25). Each dimension was subdivided into knowledge, skills, and attitudes or values. The Likert scale responses were Strongly agree (5), Agree (4), Neither agree nor disagree (3), Slightly agree (2), and Not at all agree (1). The instrument in its first version was based on three dimensions (this version was the one applied in this research) and in its second version the instrument integrated the innovative thinking dimension (Castillo-Martínez & Ramírez-Montoya, 2022). Cronbach's Alpha analysis was performed, and it was possible to determine the instrument's reliability (Alonso-Galicia & Silveyra-León, 2022). A Google form was designed for the questionnaire application to make it easier for the students to answer. Previously, validation was carried out through expert judgment, complemented with the aforementioned statistical tests: Cronbach's Alpha and Student's T-test. Cronbach's Alpha is considered a measure of the reliability of a scale. It allows measuring the internal consistency, i.e., how closely sets of items are related in a group (UCLA, n.d.). The procedural decision for a statistical test requires that some functions of the observable data are compared to the hypothesis (theory). Typically, this comparison is made through the statistical t-test, whose probability distribution is fully specified through the Ho hypothesis (Arfken & Harris, 2013).

4. Results

To determine the validity of the data collection, it was considered that although the calculation of Cronbach's alpha is a good indicator of internal consistency for an instrument with more than twenty items, as is the case of the eComplexity questionnaire, it is nevertheless important to take into account that it is a multidimensional instrument, so it was convenient to use the Spearman-Brown approximation (Schmitt, 1996), which is still derived from Cronbach's alpha but with a slightly different mathematical approximation. In this case, we used this approximation given by the equation: k(average of correlations)/(1+ (k-1)average of correlations). In this case, where k is the number of items in the instrument, 25. The result was a Cronbach's alpha of 0.921, which indicates a high degree of reliability.

The overall mean and item means were calculated for the students' perception of their mastery of the reasoning-for-complexity competency. The overall mean was 4.04, with a deviation(s) of 0.35. Table 1 shows the item means distributed among the three types of thinking that constituted the eComplexity instrument.

Table 1. Means per item by types of thinking: systemic, scientific, and critical thinking.

Means by type of thinking									
Systemic thinking									
	1	2	3	4	5	6	7	8	9
average=	4.16	4.02	3.98	4.06	4.06	4.32	4.03	4.52	3.89
s=	0.371	0.350	0.345	0.356	0.356	0.396	0.351	0.428	0.331
Scientific thinking									
	10	11	12	13	14	15	16	17	
average=	3.92	4.01	4.03	3.85	3.66	4.17	4.05	4.09	
s=	0.336	0.349	0.353	0.326	0.300	0.374	0.355	0.360	

(Continued)

Table 1. Means per item by types of thinking: systemic, scientific, and critical thinking. *(Continued)*

Means by type of thinking									
Critical thinking									
	18	19	20	21	22	23	24	25	
average=	3.83	3.74	4.12	3.95	3.90	4.11	4.16	4.47	
s=	0.322	0.310	0.366	0.340	0.332	0.364	0.371	0.421	

Source: Own creation.

As can be seen in Table 1, in general, students had a high perception of their level of mastery of the reasoning-for-complexity competency, and it can be seen that there is not a high degree of variability in the respondents' answers.

When performing the analysis for gender, the overall men's and women's means were calculated and for each type of thinking. The item "I prefer not to answer" was integrated into the questionnaire; similar calculations were made for the overall mean and standard deviation by type of thinking. See Table 2.

Table 2. Overall mean for men and women and by type of thinking.

Gender	**Calculation of:**	**Global**	**Systemic Thinking**	**Scientific Thinking**	**Critical Thinking**
Men (55)	mean	3.98	4.04	3.92	3.98
	s	0.84	0.8	0.89	0.84
Women (59)	mean	4.12	4.20	4.07	4.10
	s	0.79	0.76	0.79	0.83
I prefer not to answer (2)	mean	3.32	3.61	2.81	3.50
	s	0.84	0.61	0.83	0.89

Source: Own creation.

As shown in Table 2, women have a higher perceived level of mastery of their reasoning-for-complexity than men, but the difference in means is only 0.14 points. The two respondents who selected the option "I prefer not to answer" about their gender obtained a lower mean (3.32). Men have the highest mean in their perceived level of mastery in systems thinking (4.04), as do women (4.20). Another essential analytical statistic is the means by item because these identify more specific aspects of each type of thought. Table 3 shows the means of the female and male items, distributed by type of thinking.

Table 3. Item means of women and men by type of thinking: their perception of systemic, scientific and critical thinking.

Means by type of thinking for men and women					
		Men		**Women**	
Categories	**Item**	$\bar{X}$	**s**	$\bar{X}$	**s**
Systemic thinking	1	4.11	0.528	4.20	0.531
	2	4.07	0.520	4.00	0.487
	3	3.93	0.489	4.07	0.501
	4	3.91	0.485	4.20	0.531
	5	3.96	0.497	4.17	0.523
	6	4.25	0.561	4.41	0.576
	7	3.91	0.485	4.14	0.516
	8	4.53	0.624	4.53	0.602
	9	3.69	0.441	4.08	0.505

Means by type of thinking for men and women					
		Men		Women	
Categories	**Item**	$\bar{X}$	**s**	$\bar{X}$	**s**
Scientific thinking	10	3.87	0.477	3.98	0.484
	11	4.02	0.508	4.02	0.491
	12	3.95	0.493	4.15	0.520
	13	3.85	0.474	3.90	0.466
	14	3.58	0.420	3.80	0.446
	15	4.16	0.541	4.24	0.538
	16	3.91	0.485	4.22	0.534
	17	4.00	0.505	4.22	0.534
Critical thinking	18	3.84	0.470	3.81	0.449
	19	3.69	0.441	3.80	0.446
	20	4.09	0.524	4.17	0.523
	21	3.85	0.474	4.03	0.494
	22	3.87	0.477	3.95	0.477
	23	3.96	0.497	4.32	0.557
	24	4.16	0.541	4.15	0.520
	25	4.40	0.595	4.56	0.610

Source: Own creation.

Table 3 shows that women perceived a higher level of mastery in systems thinking for organizing information to solve research problems efficiently and effectively (item 6). Regarding scientific thinking, items 15 (I analyze the problem from the general to the particular and vice versa) and 16 (I generate and evaluate research hypotheses) indicate that the women perceived they had a higher level of mastery. For critical thinking, item 25 (I appreciate criticism of my writings to improve them as often as necessary) obtained the highest mean.

Men considered that they have a higher level of mastery in the attitudinal part of systems thinking, as seen in the mean of item 8 (I value learning something new in the field of research). In scientific thinking, they coincided with women in item 15 (I analyze the problem from the general to the particular and vice versa). Finally, in critical thinking, like women, they perceived a higher level of mastery of appreciating criticism of their writings to improve them as often as necessary (item 25).

To verify the hypothesis (H1): There is significant evidence of a gender gap in developing the complex thinking competency and its sub-competencies in students in an entrepreneurial training program. A student's t-test was performed; the results are shown in Table 4.

Table 4. Difference in means for each type of thinking: systemic, scientific, and critical.

Systemic thinking			
Item	**Dif (M-W)**	S^2_p=	t_m=
1	-0.09	0.280	-0.95
2	0.07	0.253	0.77
3	-0.14	0.245	-1.51
4	-0.29	0.259	-3.08
5	-0.21	0.261	-2.15
6	-0.15	0.323	-1.43
7	-0.23	0.251	-2.41
8	0.00	0.376	0.02
9	-0.39	0.226	-4.42
Overall mean	-0.16	0.27	-1.63

(Continued)

Table 4. Difference in means for each type of thinking: systemic, scientific, and critical. *(Continued)*

Systemic thinking			
Item	**Dif (M-W)**	**S^2_p=**	**t_m=**
Scientific thinking			
10	-0.11	0.231	-1.22
11	0.00	0.249	0.01
12	-0.21	0.257	-2.18
13	-0.04	0.221	-0.50
14	-0.21	0.188	-2.64
15	-0.07	0.291	-0.73
16	-0.31	0.261	-3.25
17	-0.22	0.271	-2.26
Overall mean	-0.15	0.24	-1.59
Critical thinking			
18	0.02	0.211	0.26
19	-0.11	0.196	-1.27
20	-0.08	0.274	-0.80
21	-0.18	0.235	-1.98
22	-0.08	0.228	-0.85
23	-0.36	0.279	-3.62
24	0.01	0.281	0.11
25	-0.16	0.363	-1.41
Overall mean	-0.12	0.260	-1.22

Source: Own creation.

Two-tailed hypothesis tests with an α=0.05 and gl=112 were conducted to determine whether the population means of men and women are equal. The t-student values obtained for each sub-competency are shown in Table 5 (in all three cases, $p<0.05$). The results indicated no significant difference between men and women.

Although there are no statistically significant differences with respect to the overall means by type of thinking, statistically significant differences could be identified in some items with respect to the perception of men and women regarding their level of mastery. The statistically significant differences could be determined in the identification of databases in their discipline and other areas to contribute to their research (item 4), participation in projects that present challenges/problems to be solved with multidisciplinary perspectives (item 5), solving research problems by interpreting data from different disciplines (item 7), application of strategies that facilitate the comprehension of complex texts (item 9), identification of the structure of a research article used in their area or discipline (item 12), design of research instruments consistent with the research method used (item 14), generation and evaluation of research hypotheses (item 16), truthfulness rating through data analysis (item 17), review of their submissions with ethical guidelines before sending them for review (item 23).

5. Discussion

The results confirm that no statistically significant evidence supports differences between men and women regarding their perceived level of mastery of the reasoning-for-complexity competency in general. However, when analyzing the results by sub-competencies (Table 2), there is a tendency for women to have a higher perception than their male peers.

This becomes even more obvious when analyzing the results by item, where women show a positive trend in 20 of the 25 items, which, although not statistically significant, do show a better perception by women. Of the 5 items where the female perception was not higher, two yielded similar results (items 8 and 11), and the remaining three (items 2, 18, and 24) showed a positive male tendency, although it is essential to note that the differences were marginal (4.00-4.07; 3.81-3.84; 4.15-4.16).

Based on this, it can be concluded that there is no statistically significant gap in the perception of achievement of complex thinking competency between men and women in the sample group, even though women perceive themselves as having a higher level of development than their male peers in many items. Thus, the hypothesis is rejected, placing the attention of the research on elements external to academic training, which, at least for considering the development of complex thinking, is not justified.

These results are in line with studies carried out by Monterroso et al. (2017), Janusz et al. (2018), Nagahi et al. (2019), and Vico and Rebollo (2019), who stated that women have a greater tendency to solve complex problems by recognizing their individuality and also the role they play as part of a group. The results also align with Sargot (2017), Marmo and Celica (2017), and Onditi and Odera (2021), who connected a more significant development of critical thinking in women as part of their process of self-identification within masculinized societies. Contrast can be found in the studies of Heybach and Pickup (2017) and Di Tullio (2019), who considered the existence of a gender gap in the development of scientific thinking as a result of inequality in the exposure of research projects within the formative processes between male and female students, this can be refuted in the present study, where women demonstrated a higher perception of achievement.

However, the same studies by Heybach and Pickup (2017) and Di Tullio (2019), as well as those by Arredondo et al. (2019), consider that academic places may not be determinant in explaining the existing gap between men and women when it comes to entrepreneurship. Although women show a higher performance perception, governments must invest more in female entrepreneurship, the little opportunity for women in the research culture of the Latin American region, and the social and cultural factors that limit female entrepreneurs. As pointed out by Arredondo et al. (2019), and consistent with the results of this article, the gender gap in entrepreneurship does not lie in the entrepreneurial capacity or profile of young women but in the lack of opportunities and support for entrepreneurship.

According to the Ecosystem of Latin American Startups in Seed Stage, prepared by Platzi (Mesalles, 2021), only 30% of emerging businesses in the region have female participation. If we look specifically at technology-based ventures, the gap becomes greater: according to the Global Startup Ecosystem Report 2021 (Startup Genome, 2021), only 14% of these ventures worldwide were created by women. The reasons are multiple, ranging from the lack of cultural incentives for women to study STEM careers, the entrenched gender stereotypes and socioeconomic barriers that segregate almost 80% of working women in the region to sectors of low productivity, and even the labor constraints on female talent that have caused less than 20% of technology vacancies in Latin America to be filled by women (Vázquez-Parra, Amézquita-Zamora, et al., 2022). As a result, women's entrepreneurship has little participation in the market, and, therefore, although the entrepreneurial spirit and the desire for entrepreneurship exists, it does not materialize.

6. Conclusions

There is no doubt that studies on the gender gap in different social, economic, and academic spheres will continue to be relevant and necessary, especially in Latin America, where the influence of the social imaginary and the predominantly patriarchal culture continues to be rooted in people, institutions, and public policies. It manifests in women, who, although they can develop as well as their male counterparts, are limited within complex environments of which they do not feel part. For this reason, the present exploratory study has sought to analyze the perception rather than the level of achievement as such, considering that perception is a priority for people to exercise their capacity optimally.

Thus, this article reinforces the need to develop environments beyond academia and theory, guaranteeing committed follow-through to equality promoted within educational institutions. Although universities seem to value reducing the gender gap between male and female students, it is a moot point if there is no follow-up with public policies that work to ensure equity. It is a significant problem in entrepreneurship, where, as can be seen in the results of this article, today, the educational gap is increasingly smaller. Still, we have yet to manage to guarantee equality at the time of starting up entrepreneurial ventures.

The practical implications of these exploratory results point to the need to establish training and follow-up processes that go beyond the classroom, linking academic work with concrete economic and governmental actions that support women's desire for entrepreneurship. It is recognized that this article may be limited by not following up on the results beyond the refutation of the hypothesis. However, the results are valuable, as they draw attention to what needs to be addressed beyond the educational environment. International organizations urging universities to develop entrepreneurship should consider that this effort cannot remain isolated to the classroom or entrepreneurial ecosystems. If the local or regional environment is not addressed, the projects

may remain just good ideas and few results. Another limitation is clearly the small sample of students; however, as explained above, this responds to the fact that this is an exploratory study and that, due to institutional regulation, the implementation must be limited. Even so, by giving these results, it will be possible to continue the study in more representative samples for validation. In this sense, it is recognized that the results presented here are not exhaustive, but that does not minimize their value.

Another aspect that is important to point out is that the present instrument contains three subcompetences of thinking; however, the authors of this article and the other members of the interdisciplinary research group R4C: Scaling up complex reasoning for all, of the Tecnologico de Monterrey, now study complex reasoning considering a new instrument that includes a fourth type of thinking: innovative. However, it was valuable to share the results of applying the first instrument for the analysis regarding the perception of complex reasoning and entrepreneurship competencies from a gender perspective.

In conclusion, this article highlights the long road ahead to reduce the gender gap in entrepreneurship. Although there has been clear progress, as seen in the results, more is needed to ensure that men and women with an entrepreneurial spirit can carry out their projects. It is necessary to join institutional and governmental efforts to improve the environment for women at the time of entrepreneurship since only in this way can the reality align with the capacity in which every woman with the desire to undertake ventures has not only the knowledge and skills to do it but also the economic, social, legal, and resource support to make it a reality.

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