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Comparison of Complex Thinking Skills between Students from Public and Private Institutions in Mexico

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The purpose of this article is to present the results of a study conducted on a population of students from two technological universities in Mexico. The intention was to contrast the perceived achievement of the complex thinking competency and its sub-competencies among students in the last levels of their training. Then, to identify areas of opportunity for developing professional competencies it was applied a sample of 551 Engineering and Business school students from two higher education institutions in this Latin American country. In this manner, 60,61% corresponded to public universities while 39,39% remaining corresponded to private universities. Methodologically, a statistical descriptive analysis was carried out. The study was conducted with a convenience sample answered by students from technological universities located in western Mexico through Google Forms. After analyzing the results, it was possible to identify a gap in the students' perceived achievement in both institutions, with the private institution having a significantly higher mean. This study raises the importance of guaranteeing the development of professional competencies equitably among all students, intending to avoid differences that impact their perceptions of their abilities. All of this considering that complex thinking as a set of disciplinary and meta-competences should be similarly taught indifferent the type of university or higher education institution.

Keywords: professional education, educational innovation, future of education, complex thinking, public, private universities

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INTRODUCTION

Undoubtedly, every university institution aims to contribute to the development of its students, which is focused on acquiring knowledge and mastering skills that will make them competent professionals throughout their lives. To meet this objective, universities have multiple tools at their disposal, including innovative educational models, cutting-edge pedagogical designs, academic literacy approaches, specialized human resources, state-of-the-art technology, and student experience programs that contribute to their well-being and integral development as future professionals (Martínez-Villalba & Sánchez-Muñoz, 2018; Suárez-Brito et al., 2022). Thus, each university builds its own strategy to achieve its objectives and missions; students at the end of their formative processes represent the success or failure of their academic guidelines. This occurs within the educational system and the regulatory framework for each educational level in each country that seeks to respond to the needs and requirements of society (Mader, Scott, & Razak, 2013).

Environmental elements directly influence whether a particular institution offers more or fewer opportunities to its students since the educational system of a country or region must accommodate the characteristics and realities of its social environment and the capacities and particularities of each higher education institution. In areas such as Latin America, a gap divides public and private higher education institutions, their source of financing being a significant element that impacts education (Avila, 2007). While some institutions depend entirely on their ability to generate resources, others receive substantial government support. However, as reflected in the various university rankings, this is not an element that determines educational quality (Altbach, 2012; Hayter & Cahoy, 2018).

Considering the above, this article presents the results of a study conducted on a population of students from two technological universities in western Mexico, one public and the other private. The intention was to compare the perceived achievement of the complex thinking competency and its sub-competencies among students in the last third of their training at both institutions to identify significant areas of opportunity to develop professional competencies. Complex thinking was chosen because it is a transversal competency that impacts all professionals and is a valuable skill for problem-solving and addressing life challenges (Smith & Knowles, 2017; Rumahlatu, Sangur & Liline, 2020; Suárez-Brito et al., 2022; Suwartini et al., 2022).

Therefore, the development of student competencies in universities and institutions of higher education is an issue that is currently relevant to the future of higher education. Thus, it is clear that countries in general are making important efforts to modernize their educational systems so that their students and future professionals can be more qualified to meet the challenges faced by contemporary society. Thus, education adapts to new technologies year after year and in the same way it also seeks to make citizens aware of different problems that make it necessary for their profiles to be more multidisciplinary in order to face the new realities that globalization has brought.

In this sense, this paper seeks to analyze the perceptions that may arise in the higher education model of the same country. All this, from the perspective of two different types of universities or educational institutions.

In this study, authors look for present the results of a study conducted on a population of students from two technological universities in Mexico. The intention was to contrast the perceived achievement of the complex thinking competency and its sub-competencies among students in the last third of their training to identify areas of opportunity for developing professional competencies. Methodologically, a descriptive analysis was carried out in this paper, seeking to identify statistically significant differences based on complex thinking in different types of universities. This is why, the current paper adopted a quantitative approach after applying a survey based on a convenience sample of 551 Engineering and Business school students. All this in Mexican higher education institutions in this case distributed in 340 students from public universities and later in 211 students from private universities. In the light of all this, this paper looks for understand the behavior of public and private universities from complex thinking competences trough some questions such as what is the perception of the level of achievement of the complex thinking competency and its sub-competencies between students from two technological universities in Mexico? and similarly what is the difference the complex thinking competency between public universities and private technological universities in Mexico?

Literature review

University education and the higher education system in Latin America

The higher education system can be understood as a paradigm or model within a given society containing the policies and guidelines for access to higher education after secondary school. It is constantly affected by the academic, scientific, business, and governmental environments. The models are constructed to guarantee specific conditions that promote practical, relevant, and cutting-edge learning among students and future professionals entering the labor market (Westerheijden, Stensaker & Rosa, 2007; Li & Yuan, 2020; Romanovskyi et al., 2021).

According to Jiménez (2007), the higher education system is usually the object of permanent attention, both by society and the professors themselves, who try to improve it through their research and teaching work, making it dynamic and involving strategic actors such as the state, the business sector, and academia. The goal is to promote quality training that generates professionals with high competencies to solve problems. In the case of Latin America, the public university is permanently in the midst of a public debate, often for budgetary reasons and other times due to challenges related to academic freedom. On the other hand, the private university, enjoying its place in a heterogeneous and very diverse sector, is usually on the margins of this type of debate. Both kinds of universities try to remain neutral organizations within society.

Regardless of all these vicissitudes, it should be noted that, in the case of Latin America, irrespective of the contrasts between these two types of universities, the higher education system seems to depend significantly on both public and private universities.

However, there was once a predominance of public universities, but this changed with the region's convulsive political, economic, and social alterations during the 20th century, leading to a proliferation of private universities. Now, official studies show that 47% of students attend public universities, and the remaining 53% enroll in private universities (López-Fernández, Crespo-Borges & Crespo-Hurtado, 2022).

The most profound transformations of higher education systems in Latin America generated a proliferation of new private universities many decades ago due to state support through public policies to develop higher education in the region's countries. Governments had bowed to financing public universities to achieve objectives related to research and knowledge development, and social projections, which resulted in quality education. However, with the various economic crises and the constant challenges of public administration in the region, budgets for public universities tended to decrease in proportion to population growth; thus, private universities expanded. It is estimated that student enrollment quintupled in less than a century worldwide. Latin America and the Caribbean account for about 13% of global enrollment. There are currently approximately 170 million students, and it is projected that by 2025 it will reach about 260 million students (Lizaola, Hurtado & Ariza, 2018).

Thus, the current Latin American scenario evidences several changes, including curricular changes due to the social and productive demands of the new knowledge society and international standards. Higher education institutions increasingly tend to implement quality assurance systems, which involve the institutional restructuring of academic offerings and universities' administration and management (Zapata & Tejeda, 2009; Goetsch & Davis, 2014).

Currently, national and international higher education markets have adapted to the delocalization and ubiquity of educational offerings and the provision of educational services resulting from developing and implementing information and communication technologies. In some instances, this leads to contradictions in implementing a competency without territorial or productive foundations in higher education programs that are distanced from the real labor world. On the other hand, some partnership contributions enhance Latin American education with innovative agreements, offering dual degree programs and research collaboration. This resounds positively in universities that seek to provide quality learning. Public universities may receive exemptions or funds for their operations, while private universities benefit from certain government prerogatives or distinctions (Malagón-Plata, Rodríguez-Rodríguez & Machado-Vega, 2019; Ossenbach, 2000).

So, the higher education system depends on various agents or aspects that intervene in its development (see Figure 1). One of these is globalization, which conditions the functioning of any university, as has been happening in Latin America. Also, the roles of the state and international organizations are essential in defining the approach to teaching based on trends and best practices that, in principle, determine the notion or construct of quality. Even the conditions of the environment in a given region are critical because the sociocultural reality of a country or group of countries sets specific trends for how the education system should be deployed (Spring, 2008).

Likewise, new theoretical and technological advances, as well as the current characteristics of the knowledge society, lead the higher education system to make essential adjustments to keep up with the challenges and problems that the world experiences over time (Hargreaves, 2003; Vitale, 2006; Altbach & Knight, 2007).

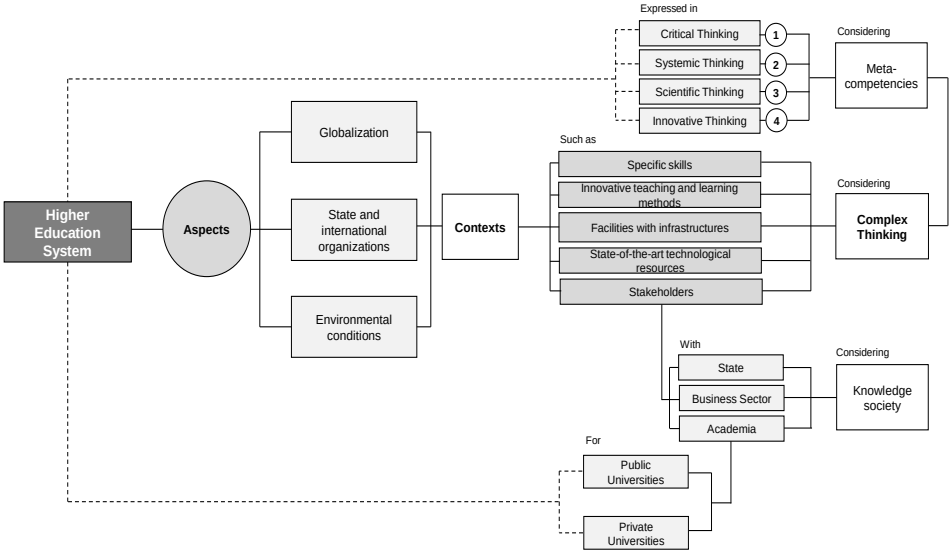

Figure 1
Aspects involved in the development of the higher education system
Source: Created by the authors

Therefore, among the main challenges facing higher education systems in general, obviously including Latin America and the Caribbean, are the flexing of education, the continuous updating of higher education programs, the linking of universities (public and private) and the labor market, and the training of teachers in digital skills, among many others (Morales-Salas & Rodríguez-Pavón, 2022).

That is to say, higher education should be oriented to the achievement of the capabilities required for each country's social and economic development, in addition to other purposes, since the present has acquired a strategic dimension within the field of knowledge. The rapid and constant evolution of technological resources leads to the reconfiguration of education, bringing new perspectives. For this reason, it is essential to define it from different angles, considering all its actors and situations. Analyzing and rethinking its objectives becomes vital, given the diversification of resources for teaching and learning processes. That is why current studies on any social problems are usually approached in a multi, trans, and interdisciplinary way to achieve a holistic intervention of each aspect. Thus, complex thinking provides a comprehensive perspective that considers the factors that enhance higher education and understanding its causes and effects (Serrano-Barquín, 2020; Baena-Rojas et al., 2022).

Due to the above, higher education must respond to societal needs today and tomorrow. It must adopt innovative and disruptive strategies that allow university students, especially in Latin America, to acquire specific meta-competencies of complex thinking to become suitable, integral professionals who have the knowledge and skills to problem-solve in the various areas where they will work (Vázquez-Parra et al., 2022). All this is in the context of a challenging present where students must be trained to achieve specific skills with innovative teaching and learning methods in centers with state-of-the-art technological infrastructures and resources. These centers must effectively integrate other stakeholders, such as governments, businesses, and higher education institutions (Ramírez-Montoya et al., 2022).

Development of competencies in university education

Today's university seeks to provide education focused not just on transferring knowledge but on mastering core competencies, enabling students to acquire knowledge independently. The competency-based approach to teaching is well-known to educators, scientists, and employers worldwide and is currently discussed from diverse angles (Ramirez-Mendoza, et al., 2018).

Students are recognized as competent when they can efficiently organize the personal or external resources available to achieve an objective. When we talk about types of personal resources, we refer to skills, knowledge, activities, psychological traits, values, and other elements that personally shape the person. Universities currently set an objective that their students attain quality education, experience situations fully, and above all, reflect on affirming that they have and perceive competencies that will characterize them in their life after their studies (Hill, et al., 2019; Sari, et al., 2021).

Each university establishes the types of competencies for its graduates through a series of strategies to achieve this objective. Without classifying these competencies, we can demonstrate that they are distinguished by features such as mastery of means, methods, and techniques to perform a specific task, having a set of knowledge to complete a job, willingness to perform the task in question, and willingness to make an effort to achieve these objectives (Ahhmetshin et al., 2019).

In this manner, if some papers focused mainly in terms such as "complex thinking" and "universities" are analyzed. All this, in recognized databases such Scopus where are published high quality research papers. It is possible to recognize some articles which reveals the main clusters, see Figure 2, where come from relevant literature in complex thinking related with higher education institutions.

Hence, Saye & Brush (2002) affirm that complex thinking is the result of higher education institutions with a substantial availability of resources such as professors, media, and other different technologies, which allow improving competences and skills in students. It is necessary to add that the undergraduate program curriculum is relevant in order to enhance that professor with cognitive science boost new knowledge by means of experimentation for developing cutting edge competences in students.

Similarly, complex thinking requires the active guidance of the self, but simpler mental activities do not. In this sense, the implementation of essential elements such as attention regulation, cognitive extrapolation, reflective reading comprehension is essential. All these can then have an impact on reaching a series of general knowledge as resources, so far, proper to the human mind. (Schmeichel, Vohs & Baumeister, 2003).

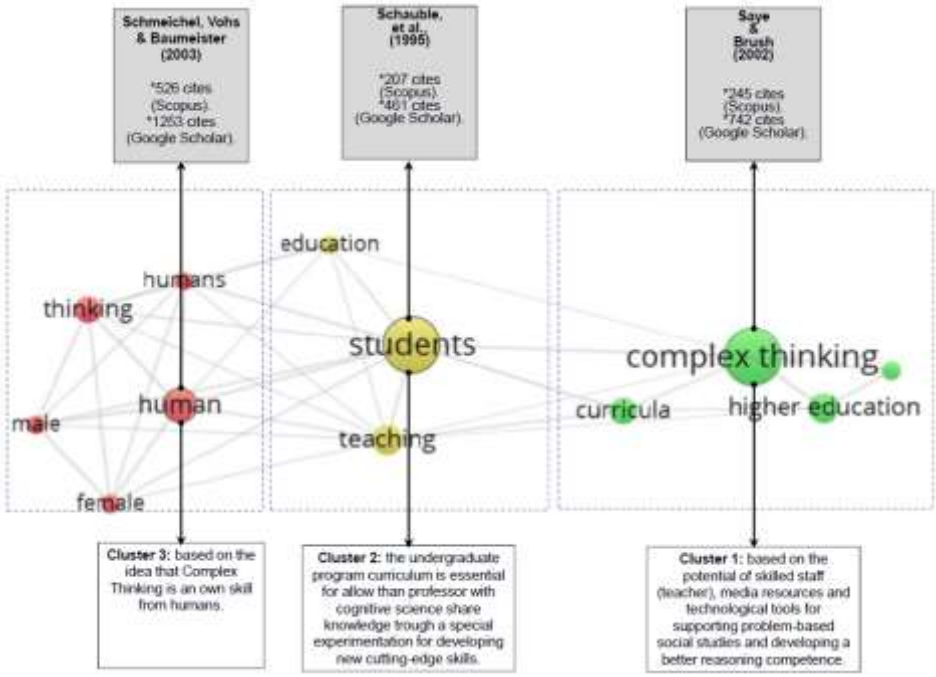

Figure 2
Main clusters which lead to complex thinking in higher education institutions.
Source: Created by the authors

Thus, the development of graduate competencies is a priority issue for universities in their search for long-term learning strategies. Still, the promotion of competencies is not only a task of the university environment; companies increasingly value the acquired competencies of their potential collaborators (Akondy & Murthy, 2015). In any case, however, it should be clear that in order to develop complex thinking, it is not only the planning of universities and higher education institutions that is necessary. The way in which states and their governmental institutions manage their resources is meaningful to guarantee access to higher education. Therefore, the possibility for members of a society to study is a determining component for the evolution and social development of regions and countries. This aspect, in fact, is understood as a key element for the measurement of relevant economic indicators such as, for example, the human development index (Herrero-Olarte & Baena-Rojas, 2022).

In other words, the initiatives of central governments and their different public policies can clearly have an impact on the quality of higher education. In this sense, public universities may be more vulnerable to not reaching the expected goals in terms of creating competencies in their professionals, affecting their own quality. While private universities depend on other means to generate their results in the creation of competencies and training of professionals (Di Masi & Santi, 2016; López-Caldera, 2017).

Precisely, Cabral & Dhar, (2019) analyzed the importance of developing competencies, focusing on national institutions, and the necessity of this development in the face of technological changes. They discussed that achieving this objective becomes an effective way to empower not only men but also women in the country and integrate the development of competencies in high school and university students. It is essential to highlight the impact of reforms in the labor world to achieve harmony between theory and practice, emphasizing increasing incentives to overcome the lack of qualified teachers.

There are various types of competencies. Let's consider the qualities of a learner (values, meanings, knowledge, skills, abilities, etc.) that are driven by the experience of his activity in a specific socially and personally significant sphere. These competencies are the essence of "motivated skills" and correspond to values (Raven, 1984; Browne & Keeley, 2007; Krstikj, et al., 2022). According to this definition, when training models are developed during this period, competencies result from the learning process. Some of them are:

- Willingness and ability to learn independently.
- Self-confidence.
- Adaptability: no feelings of helplessness.
- Tendency to think ahead: the habit of abstraction.
- Independent thinking and originality.
- Critical thinking.
- Willingness to solve complex problems.

This last competency is the reason for our study. It arises as an extension of problem-solving, generating the capacity for scientific and systemic thinking, among others. According to (Fissore et al., 2020), problem-solving is the ability to understand the environment and identify problems and complex situations so that, by reviewing the information related to the case, one can develop or evaluate strategies for implementing solutions and reach the desired result. Problem-solving enhances the ability to solve complex situations with many avenues of resolution. In higher education, educational modules are designed to develop the competency of complex thinking in students as a goal (Zhang & Tejeda, 2009).

Complex Thinking and its Sub-competencies

According to the Latin complexus, the term "complex" is defined in terms of the words intertwining, encompassing, and surrounding a whole. In (Zamora-Araya, 2019), it is established that if the objective is to confront current globalized scenarios, where diverse situations are intertwined, trying to engage them with a simplistic or reductionist perspective is fruitless. It is necessary to move towards global, holistic reasoning, that is, complex thinking that connects the different parts of the whole and the whole with its parts. In this way, we can establish that the competency of complex thinking refers to the ability to interconnect the different dimensions of the reality surrounding us.

Let us not forget that complex thinking results from individual solutions or parts, which may be sufficient to confront a situation. However, a complicated task requires the natural interaction of individual solutions; fragmenting a problem could be helpful. If this fragmentation is carried out systematized or by parts, it could lead to the final or total objective. A complex problem cannot be solved only by applying a methodology of isolated steps; a global understanding of the context must be developed, and coordinating attitudes and actions is needed for its final resolution.

As an example of this complex approach, (López et al., 2021) described how a group of engineering students combined Education 4.0 strategies provided by the educational model of their university. It considered the demands of Industry 4.0 demanded. Thus, by executing the final project, they developed disciplinary and transversal competencies for a creative resolution to design an electric vehicle racing team; they connected the parts and established a systemic methodology. The elements of the problem were analyzed separately, a working methodology accepted by the industry was applied, and the resulting system was functional in the end. The students increased their capacity for complex reasoning in a real situation, successfully acquiring the competencies and skills needed to become technological leaders in today's modern industry.

If we analyze the components of complex thinking, we find the principal features of analytical, algorithmic, contextual, global, fuzzy, imaginative, creative, heuristic, scientific and ethical reasoning according to (Tecnologico de Monterrey, 2019). But, if we want to describe it in terms of high-level transversal competencies, we have to reference the sub-competencies or main types of thinking that define it to face the challenges already mentioned (Vázquez-Parra et al., 2022). Figure 3 shows this relationship and how they interact with each other.

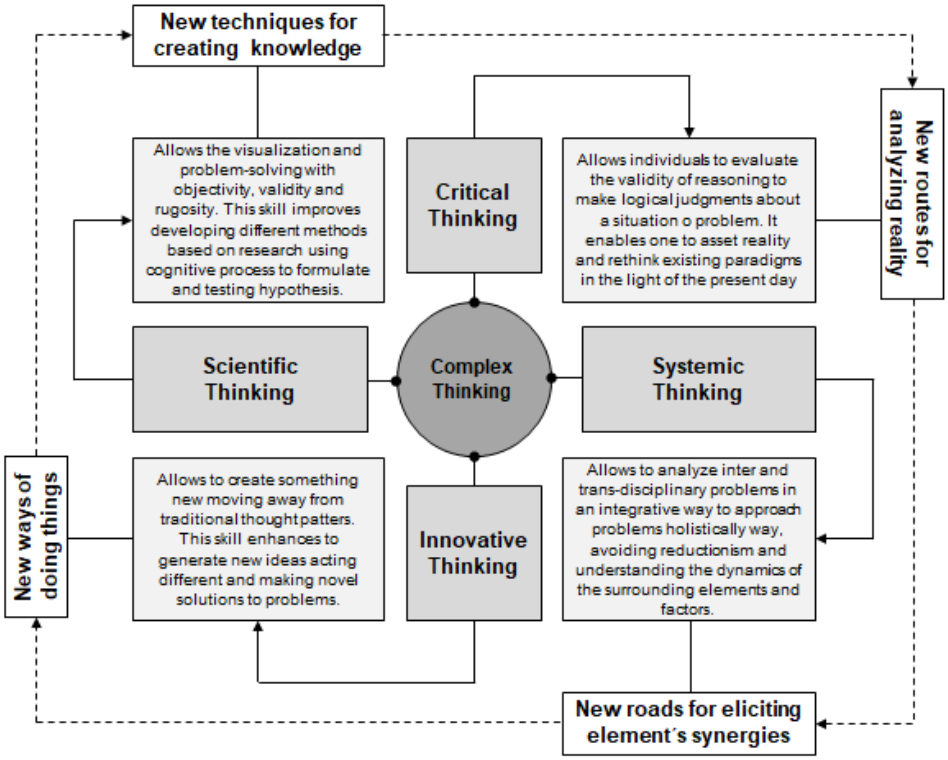

Figure 3
Complex thinking sub-competencies.
Source: Created by the authors.

METHOD

A convenience sample of 551 Engineering and Business school students from two technological universities in western Mexico were taken, the participants being in the last third of their university education. The first group included 340 students from a public university, and the second, a private university (211 students). The study was conducted in September 2022. One self-administered questionnaire answered voluntarily by the students was applied through Google Forms.

Table 1
Participant data by gender

Public University					
Men		Women		Total	
n	%	n	%	n	%
210	62%	130	38%	340	100
Private university					
Men		Women		Total	
n	%	n	%	n	%
128	65%	83	35%	211	100

Source: Created by the authors.

Being an exploratory study involving individuals, the implementation was regulated and approved by the interdisciplinary research group R4C, with the technical support of the Writing Lab of the Institute for the Future of Education of the Tecnologico de Monterrey.

The eComplexity instrument was applied in this study:

The eComplexity instrument aimed to measure the participants' perception of their reasoning-for-complexity competency and its sub-competencies. It is an instrument validated both theoretically and statistically by a team of experts in the field. The validation was verified with 443 participants who demonstrated the reliability and internal consistency of the instrument. For this validation, the criteria of Clarity (3.31), Coherence (3.38), and Relevance (3.54) were considered, determining that the eComplexity instrument was highly valid and reliable (Castillo-Martínez et al., 2022). The instrument consisted of 25 items divided into four sub-competencies: systemic, scientific, critical, and innovative (or creative) thinking. Each item was answered on a 5-level Likert scale.

The study was a multivariate descriptive statistical analysis to find patterns in the perception of the development of the complex thinking competency and each of its sub-competencies by type of university campus (i.e., private or public). The statistical analysis of the data was carried out using the computational software R (R Core Team, 2017) and Rstudio (RStudio Team, 2022).

The analysis consisted of determining arithmetic means and standard deviations, producing violin plot, boxplot, principal component analyses (PCA), and a biplot analysis of shape ($\alpha = 1$). The mean was selected as a representative value for the students' perceived development of complex thinking and sub-competencies. Likewise, the analysis of standard deviations allowed an understanding of the variation or dispersion of students' perceptions from the means. To complement the mean values and standard deviations study, the violin and boxplot analyses allowed visualizing the data behavior. First, the violin analysis allowed, through a smoothed histogram, to represent the kernel-like density of the students' perception. In addition, it combined synergistically with the boxplot analysis for a single visualization (Hintze & Nelson, 1998). The boxplot analysis, also known as a box-and-whisker plot, allows knowing the

median, means, dispersion, and data outliers by quartiles or percentiles (Williamson, 1989).

Regarding PCA, this tool allows us to know more information about how the observations (students) differ from each other by reducing the complexity of the raw data. This avoids collinearity problems, identifying independent and uncorrelated variables called principal components (Cruz-Sandoval et al., 2020). This analysis was complemented with the biplot graph (Gabriel, 1971), which allowed us to measure the distances between our observations (students) and the variables (sub-competencies) and to differentiate them by the type of university. To favor the visualization of the behavior of our students in the analysis, we produced the biplot of the form (i.e., $\alpha = 1$).

FINDINGS

At the macro level of general complex thinking competency, Table 2 shows the analysis of means and standard deviations of students' perceptions by type of university. The results show that students attending the private university perceived higher development than their public university peers (mean values of 4.23 and 3.88, respectively). Table 2 also shows that the private university had a lower standard deviation in this data compared to the public university students (0.51 and 0.62).

Table 2
Complex thinking competency. Means and standard deviations. Analysis by university type

Complex Thinking		
University Type	Mean	Sd
Public	3.88	0.62
Private	4.23	0.51

Source: Created by the authors.

Figure 4 shows the violin plot to better illustrate the previous table's results. The figure highlights the differences in the kernel-like distribution of the students' perceptions in the private and public universities. The figure shows that students attending the private university had a higher allocation of mean values between 4.0 and 4.5. On the other hand, the public university students' distribution concentrated in mean values equal to and less than 4.0.

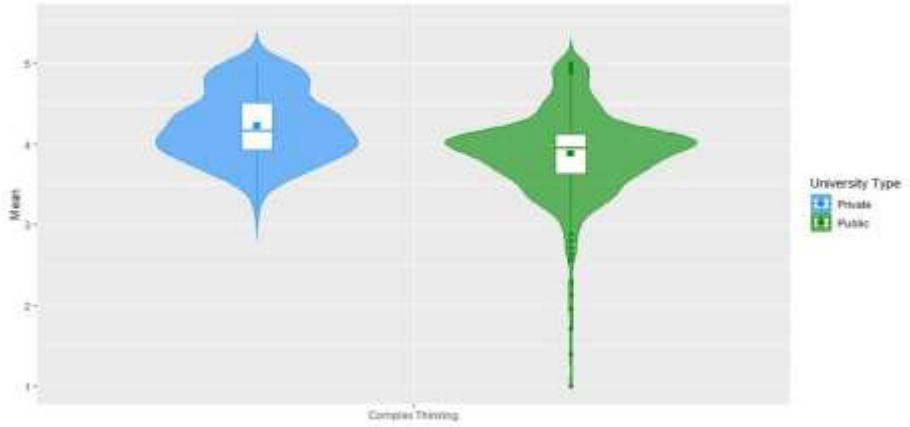

Figure 4
Complex thinking competency. Violin plot. Analysis by university type.
Source: Created by the authors

Table 3 analyzes the means and standard deviations of the students' perceived sub-competencies of complex thinking by type of university. The results show that students in both institutions had the highest mean values in the sub-competency of systems thinking, the higher one in the private institution (4.37 and 4.07, respectively). On the other hand, scientific thinking had the lowest means in both types of schools (4.06 and 3.69). It stands out from Table 3 that private university students had means higher than four in each of the sub-competencies. In contrast, in public universities, except for systemic thinking, the mean values were lower than four.

Table 3
Complex thinking sub-competencies; means and standard deviations analysis by university type

	Private University		Public University	
	Mean	SD	Mean	SD
Complex thinking	4.23	0.51	3.88	0.62
Scientific thinking	4.06	0.55	3.69	0.61
Critical thinking	4.25	0.48	3.95	0.60
Innovative thinking	4.24	0.53	3.83	0.59
Systemic thinking	4.37	0.42	4.07	0.61

Source: Created by the authors.

To better understand the results of the previous table, Figure 5 shows the boxplot analysis by sub-competency of students' complex thinking according to the type of university they attended. The figure shows low mean values in the first quartile in each sub-competency, mainly among public university students. In the case of the private university students, the outliers in the lowest quartile occurred in the innovative thinking

sub-competency. Likewise, the private university students had higher means than the public university students in all the sub-competencies.

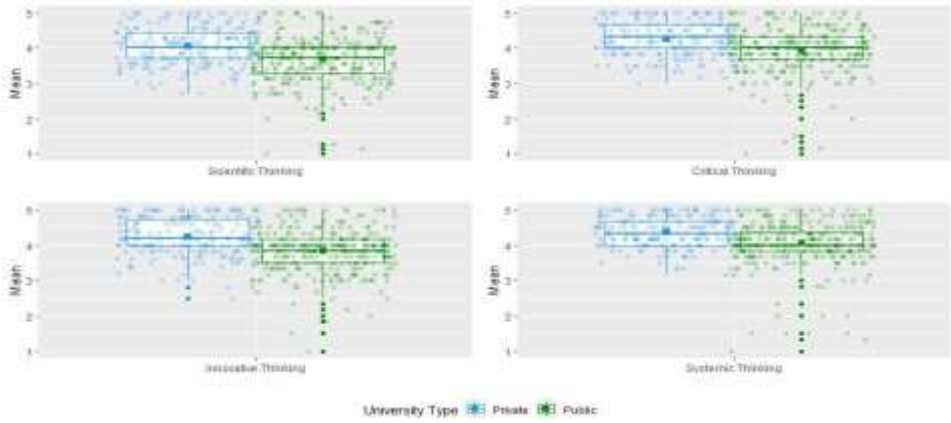

Figure 5
Complex thinking sub-competencies: Boxplot analysis by university type.
Source: Created by the authors

As part of the principal components analysis of the complex thinking competency, Table 4 shows that PC1 and PC2 explain 76% and 10% of the variability in the data. These two components together explain 86% of the variability. PC1 has a high correlation with innovative thinking, while PC2 has a high correlation with scientific and systemic thinking. So, PC1 would explain the students' ability to evaluate reality from different angles, seeking to generate original and feasible proposals and solutions. PC2 would explain the students' ability to make decisions and solve problems with objective and validated methodologies and analyze problems interconnectedly, recognizing the elements that comprise them.

Table 4
Complex thinking: principal components matrix

Concept	PC1	PC2	PC3	PC4
Scientific thinking sub-competency	0.49	0.63	0.37	0.46
Critical thinking sub-competency	0.50	-0.31	-0.67	0.43
Innovative thinking sub-competency	0.51	0.30	-0.24	-0.76
Systemic thinking sub-competency	0.48	-0.63	0.58	-0.11
Standard Deviation	1.75	0.62	0.54	0.47
Proportion of Variance	0.76	0.10	0.08	0.06
Cumulative Proportion	0.76	0.86	0.94	1.00

Source: Created by the authors.

Finally, Figure 6 shows the biplot shape ($\alpha = 1$) to display students' perception of sub-competency development by type of university. The figure shows that many private university students had data responses in the opposite direction of the sub-competency rays. This behavior supports that the public university student had worse perceived

development of the complex thinking sub-competencies. Student responses in the center or vertex of the sub-competencies indicate similar conduct in the perception of the sub-competencies. Student data in the direction of the arrows and the farthest from the directing point indicate students perceiving the best development. Mainly students in the private university perceived themselves better in the sub-competencies of scientific, innovative, critical, and systemic thinking.

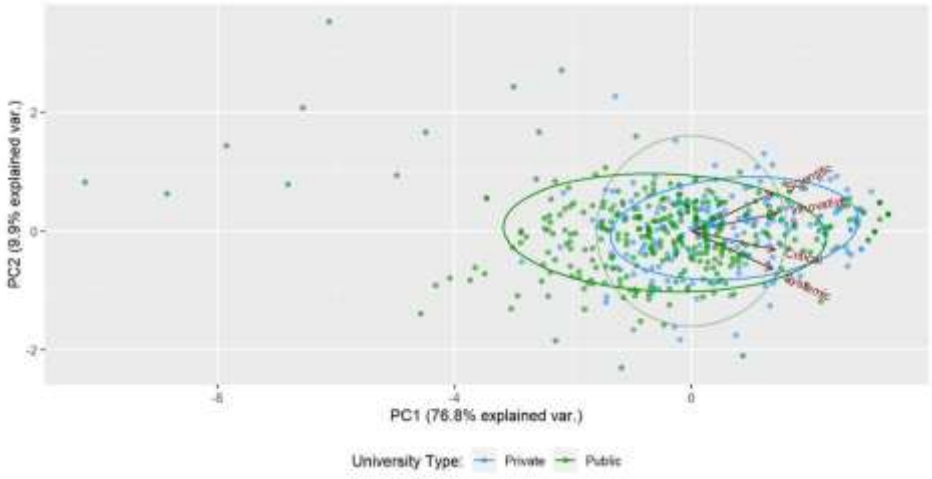

Figure 6
Complex thinking: Principal Component Biplot of the form (α = 1) explaining 86.70% of the data variability.
Source: Created by the authors.

DISCUSSION

The first results presented are the overall means of the complex thinking competency, divided between the students of the public and private universities. As shown in Table 1, there were 340 participants from public universities and 211 from private universities. As seen in Table 2, the private university average is considerably higher than the public university. In addition, Figure 4 shows a violin plot of these data indicating that students in the private institution had a strong concentration of answers between 4.0 and 5.0, even with several cases at the top of the scale. Within the violin, the deviation box is towards positive results, showing that beyond these good results, the tendency is toward the top of the scale. Conversely, the data from the public university students, although having a strong concentration of responses around the mean, also had much more standard deviation; its results ranged from the lower end of the scale (1.0) to the upper end (5.0). The violin's inner box shows that the mean is below the median, and even the deviation is downward.

These first results show a gap in the development of competencies in both populations, not only in the means but also in the distribution of responses. In the public university population, individuals perceived themselves as experts while others felt still lacking in

this competency. Therefore, we wanted to delve deeper into how the answers were given, exploring concretely how the sub-competencies data behaved in the two populations. Table 3 presents the means of both the overall competency and its sub-competencies.

Following the trend of the means shows that in all the sub-competencies, the students in the private university had stronger results since even the lowest mean of the private university (scientific thinking, 4.06) was comparable with the highest average of the public university (systemic thinking, 4.07). Interestingly, the highest and lowest results occurred in the same sub-competencies of both institutions, with scientific thinking having the lowest means (4.06 and 3.69) and systemic thinking the best (4.37 and 4.07). Although the results differ quantitatively, the competencies and sub-competencies tendencies are similar. These results may point to the differing institutional conditions of public and private universities and the individual (and collective) characteristics of the populations attending the two types of universities (Ossenbach, 2000).

To have a broader perception of these results, Figure 5 presents four boxplot graphs, one for each indicator comparing the public and private institutions. This figure corroborates the data presented in Table 3, although it allows us to more concretely appreciate the participants' behavior. It is relevant to note how once again, the standard deviation in the public institution could predominate in their results; the private institution had very few results below the mean value of the scale (3.0). This becomes visually perceptible in the public institution. The responses in the public university boxes of the four sub-competencies tend to the lower part of the scale, which could negatively impact the mean. In this sense, if we focus on the distribution, we see no significant difference in the responses in the middle-upper part of the scale between both institutions. However, there is a significant difference in the lower part.

These results show the gap between institutions and a notable difference in how the public university students acquire and develop their sub-competencies. Their graduate profile for professional requirements to face the world's complexity could be left empty for generations (Morales-Salas & Rodríguez-Pavón, 2022; Hayter & Cahoy, 2018).

Finally, combining the results of the general competency and the sub-competencies, Table 4 presents a principal components analysis, and Figure 6, a Biplot graph. In this figure, it is possible to note how the concentration of both institutions, although similar in the center, shows a different trend at the extremes. The responses of the public university tend toward negative results in contrast to the results of the private university, which offers a positive direction. Notable is the number of public university student values that fall out of the central concentration and could be outliers, which is not so noticeable in the responses from the private university students. It is important to note that although there are negative outliers in the public institution, there are also samples of positive values. The biplot shows that the highest values are presented by students from the public university.

CONCLUSIONS

In conclusion, these results yield two valuable findings. On the one hand, there is a statistically significant gap in students' perceived achievement of the complex thinking competency and its sub-competencies by type of school, public and private university. The second finding is a possible internal gap in the public institution, which could indicate inequality among its students when acquiring and developing professional skills. This provides a guideline for analyzing public policies for the educational field and designing pedagogical strategies to promote higher levels of complex thinking and the four sub-competencies. Educational institutions, whether public or private, must ensure that all their students acquire and develop professional knowledge and skills and perceive themselves as competent. This study's data are relevant because it points to a need for attention on the part of this public institution. Students in the last third of their professional training should yield results that reflect perceived competencies at an advanced level, so this work invites new studies that shine a light on the training process of this public institution.

It could be said that this descriptive analysis is limited because it samples only two institutions. However, we believe that it is valuable for its findings and the possibility of triggering new studies that concretely analyze the specific reality of each institution. It would be relevant to consider particular population characteristics, such as gender or employment status, as these could influence the sampled students' perception of perceived competencies. Even so, the results of this exploratory study are valuable for public and private higher education institutions to have a background not only on students' acquisition of competencies but also on how these are developed in their students. They should pay particular attention to reducing any possible gap that could generate inequalities in the internal training process. This provides a guideline for analyzing public policies for the educational field and designing pedagogical strategies to promote higher levels of complex thinking and the four sub-competencies.

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