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# Development of Social Entrepreneurship Competencies and Complex Thinking in an Intensive Course of Open Educational Innovation

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## Abstract

This article aims to show the results of implementing a training methodology in a group of participants within an intensive course on educational innovation. The motivation for this course was to promote innovative ideas that could be scaled into possible open educational entrepreneurship projects. Based on descriptive statistical analysis, that included a multivariate statistical analysis, an analysis of means and nonparametric tests of the data comparison of medians and ranges and Spearman's correlation, this article considered the SEL4C methodology, which was intended to support the ideation process and develop the participants' perceived achievement of social entrepreneurship and complex thinking competencies. The proposed methodology was validated to develop social innovation ideas even in a limited time and improved the participants' perception of achieving both competencies. This article contributes to the validation studies of this methodology and the academic approaches that seek efficient tools for acquiring and developing transdisciplinary competencies.

## Keywords

Professional Education, educational innovation, future of education, complex thinking, social entrepreneurship, higher education.

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## **Desarrollo de Competencias de Emprendimiento Social y Pensamiento Complejo en un Curso Intensivo de Innovación Educativa Abierta**

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### **Resumen**

Este artículo pretende mostrar los resultados de la aplicación de una metodología formativa en un grupo de participantes de un curso intensivo sobre innovación educativa. La motivación de este curso fue promover ideas innovadoras que pudieran escalar en posibles proyectos de emprendimiento educativo abierto. Basándose en un análisis estadístico descriptivo, que incluye un análisis estadístico multivariable, un análisis de medias y pruebas no paramétricas de comparación de medianas y rangos y una correlación de Spearman, este artículo empleó la metodología denominada SEL4C, la cual pretendía apoyar el proceso de ideación y desarrollar la percepción de logro de competencias de emprendimiento social y pensamiento complejo por parte de los participantes. La metodología propuesta fue validada para desarrollar ideas de innovación social incluso en un tiempo limitado y mejoró la percepción de los participantes sobre el logro de ambas competencias. Este artículo contribuye a los estudios de validación de esta metodología y a los planteamientos académicos que buscan herramientas eficaces para adquirir y desarrollar competencias transdisciplinarias.

### **Palabras clave**

Educación profesional, innovación educativa, futuro de la educación, pensamiento complejo, emprendimiento social, educación superior.

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Open education is an international initiative that seeks to make educational resources freely and openly accessible and usable by anyone, including texts, videos, and images, among other educational elements (Ramírez-Montoya et al., 2022). This movement promotes the creation and distribution of materials for use, re-use, and adaptation by educators and students worldwide to improve access and quality of education and foster collaboration and knowledge sharing among educators, students, and experts (Kiripi, Ailwei, & Van-Wyk, 2022).

A fundamental part of the open educational movement is the ability to create new resources and contribute to continuously improving existing ones (DeRosa & Jhangiani, 2017). Therefore, the promotion of environments and methodologies that trigger innovation has become a vital issue for this initiative because it allows academicians, researchers, and educators to originate, share, and adapt educational materials openly and collaboratively to develop new ideas and approaches that improve learning and teaching (Siphamandla & Mthethwa, 2022).

Accordingly, the United Nations Educational, Scientific and Cultural Organization (UNESCO-ICDE, 2023), collaborating with higher education institutions, governmental and non-governmental organizations, businesses, and other stakeholders, created the UNESCO Chair in Open Education for Latin America. This initiative promotes open education and lifelong learning, fosters equitable access to education and knowledge, and improves educational quality through information and communication technologies (UNESCO-ICDE, 2023). As part of the work of this Chair, working meetings are held in which researchers and educators from different parts of the world meet to trigger innovative ideas for open training tools that facilitate achieving the Sustainable Development Goals (SDGs), particularly SDG 4 on quality education, by promoting access to quality education (UN, 2022).

Thus, this article presents the results of implementing the SEL4C (Social Entrepreneurship Learning for Complexity) methodology in a group of participants in an intensive course on educational innovation during the annual meeting of the UNESCO Chair in Open Education for Latin America. Based on multivariate analysis, we argue the validity of this methodology for developing innovative educational ideas and scaling the perceived achievement of social entrepreneurship and complex thinking competencies. Although there are previous studies that argue the validity of the methodology (Vázquez-Parra, Carlos-Arroyo & Cruz-Sandoval, 2023), the originality of this article focuses on its application in a time-limited intensive course, seeking to contribute to the understanding of the acquisition and development of transdisciplinary competencies in entrepreneurial ideation processes.

### **Entrepreneurship for Educational Innovation**

Educational innovation involves the application of new approaches, methods, technologies, and practices in education to improve the quality of learning and teaching, significantly changing how educational programs are designed and delivered and how students interact with content and teachers (Sofyan & Hafezad, 2022). Almost always, educational innovation is related to the use of technologies in the classroom, but its definition is broader than that in the

sense of also considering didactic or pedagogical techniques along them, such as project-based learning, the competency-based approach, personalized learning among others (Rodes & Gewerc, 2023).

Educational innovation can be characterized as a valuable tool to meet the challenges of education and improve the quality and accessibility of teaching (Alvi, 2022). Thus, although it may be driven by technological factors, labor market trends, or student demands, educational innovation is often argued as a response to social needs (Khaskheli, 2023). In this sense, there is an increasing demand to drive educational innovation processes in institutions to respond adequately and agilely to the challenges they face, such as the COVID-19 pandemic (Sultan, 2023). Although the process of generating innovative ideas may vary, the aim is to have tools that can be adapted to academicians' and designers' specific contexts and objectives (Deboever et al., 2022; Portuguese-Castro & Gómez-Zermeño, 2020).

Educational innovation and entrepreneurship are closely related, focusing on creative and practical solutions to address social challenges and opportunities (Cheung & Wong, 2018). Although traditional entrepreneurship could have a focused vision on developing new business initiatives for educational solutions just as it was pointed out in a Systematic Literature Review developed by Cantú et al (2019), the variant of innovative social entrepreneurship generates value propositions addressing social problems without necessarily requiring economic gain (García & Lytras, 2019). From this perspective, educational innovation can trigger social entrepreneurship ideas, adhering to specific needs or goals, such as those proposed in SDG 4 (García et al., 2019).

Thus, educational, social entrepreneurship aims to generate ideas and develop valuable projects that offer innovative solutions in the field of education, addressing specific challenges such as quality of learning, reduction of educational gaps, promotion of affordability, teacher training, lifelong learning, and innovation and social changes, generally (Kiviniemi & Kultalahti, 2020).

### **Complex Thinking and its Educational Impact**

Complex thinking is a cognitive ability that allows understanding and addressing the inherent complexity of systems and phenomena in the world from an integrated perspective (Drucker, 2021). It was primarily developed by the philosopher Edgar Morin, who posited that many problems and situations in real life are inherently complex, meaning that they are composed of multiple interconnected elements, influenced by diverse factors and subject to dynamic changes (Vázquez-Parra, Alfaro-Ponce, Guerrero-Escamilla, & Morales-Maure, 2023). To address these problems effectively, it is necessary to adopt an integrative thinking approach, which considers cognitive subcompetencies that complement each other in the process of analyzing the environment (Morin, 1990).

In this sense, according to Baena et al., (2022), the competence of complex thinking considers the importance of recognizing that the elements of a system are interconnected, and that changes in any of these elements can affect others (systems thinking) (It also values the importance of knowing the context and external influences in the understanding of a phenomenon or problem, accepting that systems are dynamic and changing and that it is therefore important to have methodologies that provide greater objectivity to the conclusions

reached (scientific thinking). Additionally, Silva & Iturra (2021) states that this competence considers the relevance of dialogue and communication between different perspectives, adopting a natural openness towards different points of view, which enriches understanding (critical thinking). Finally, for Brown (2019) innovation is considered, as an intrinsic need in the problem-solving process, appreciating that it is necessary to promote creativity, considering the existing, but with a constant interest in identifying new opportunities for action (Innovative thinking).

In this sense, complex thinking is a relevant skill in the process of educational innovation, since education itself is a complex system that must be appreciated in an integrated manner (Cole, 2010). The adoption of complex thinking in educational innovation processes allows for a better understanding of international and local educational challenges, considering the multiple factors that influence the teaching and learning process. In addition, it allows devising more effective pedagogical strategies, by considering the volatility and constant evolution of reality, as well as the diversity of students and their needs (Ramirez, et al., 2021). Also it is worth mentioning that complex thinking has a relationship with academic literacy illustrated by the development of a series of skills that facilitate the execution of advanced actions and the solution of problems (Suárez-Brito et al., 2022). Based on the above, promoting the competency of complex thinking and its subcompetencies within an educational innovation process is something that should be considered, since beyond innovation, it enables elements of collaboration, dialogue, adaptation and creativity necessary in naturally complex and changing educational environments (Vázquez-Parra, Castillo-Martínez, Ramírez-Montoya, & Millán, 2022).

### **The SEL4C Methodology: Social Entrepreneurship Learning for Complexity**

The SEL4C Methodology results from a research process carried out by an interdisciplinary group of educational academicians at Tecnológico de Monterrey, who pursued to develop a tool to trigger social entrepreneurship ideas to promote the acquisition and scaling of students' perceived achievement of social entrepreneurship and complex thinking competencies. This methodology is based on training social entrepreneurs, extending beyond the projects themselves (Vázquez-Parra & Ramírez-Montoya, 2022).

The methodology comprises nine training activities that aim to develop ideation for a social entrepreneurship project at a basic level. The activities were designed by a team of specialists in social entrepreneurship with training in pedagogy and instructional design, who sought entrepreneurial activities that would promote the perception of achievement of transdisciplinary competencies such as social entrepreneurship and complex thinking (see Table 1). The intention was for participants to develop a social entrepreneurship project and to perceive themselves as competent change agents (Vázquez-Parra, Carlos-Arroyo & Cruz-Sandoval, 2023).

**Table 1**

*Relationship of activities with developing the competencies and sub-competencies of social entrepreneurship and complex thinking*

<b>Activity</b>	<b>Social Entrepreneurship Competency (Sub-competencies)</b>	<b>Complex Thinking Competency (Sub-competencies)</b>
1. Triggering questions	Motivation	Critical Thinking
2. Lenses of innovation	Social Awareness; Empathy; Identification of social and environmental problems.	Critical Thinking
3. Breaking paradigms	Perseverance and Resilience; Empathy; Ethical Sense	Systemic Thinking; Innovative Thinking
4. Defining your cause	Social implications	Systemic thinking; Critical thinking;
5. Understanding the problem	Identification of problems; Social implications; Empathy; Empathy	Scientific thinking; Critical thinking
6. Reinventing value propositions	Courage and social awareness; Social innovation and financial sustainability / Valuing ideas, results, and impacts on the environment and people.	Scientific Thinking; Critical Thinking; Innovative Thinking
7. Prototyping and Validation	Tolerance to uncertainty, ambiguity, and stress; Communication and Persuasion; Creativity; Learning and Adaptability	Scientific Thinking; Systems Thinking
8. Communicate your passion	Leadership; Mobility of People; Collaborative Work; Resource Management; Economic Literacy	Critical Thinking; Systemic Thinking; Critical Thinking
9. Exploration process	Resource Management; Economic Literacy; Strategic Planning; Collaborative Work; Tolerance of Uncertainty, Ambiguity, and Stress.	Critical Thinking; Critical Thinking; Scientific Thinking; Innovative Thinking

This methodology is based on training social entrepreneurs, extending beyond the projects themselves (Vázquez-Parra & Ramírez-Montoya, 2022). The methodology comprises nine training activities that aim to develop ideation for a social entrepreneurship project at a basic level. The activities were designed by a team of specialists in social entrepreneurship with training in pedagogy and instructional design, who sought entrepreneurial activities that would promote the perception of achievement of transdisciplinary competencies such as social entrepreneurship and complex thinking (see Table 1). The intention was for participants to develop a social entrepreneurship project and to perceive themselves as competent change agents (Vázquez-Parra, Carlos-Arroyo & Cruz Sandoval, 2023). This methodology included two measurement moments, one at the beginning and the other at the end of the activities, in which validated instruments were applied to record the students' perceived development of both competencies and sub-competencies. The two measuring instruments were the Social Entrepreneur Profile instrument (García-González et al., 2021) for measuring the students' perceived achievement of the Social Entrepreneurship competency and the E-Complexity instrument (Castillo-Martínez et al., 2022) for measuring their perceived achievement of complex thinking.

### ***Social Entrepreneurship***

The Profile of the Social Entrepreneur instrument ([García-González et al. 2021](#)) is a scale with 24 questions grouped into four sub-competencies: self-control (e.g., I am tolerant of ambiguous situations or situations that generate uncertainty); leadership (e.g., I can identify the strengths and weaknesses of the people I work with); social awareness and social value and social innovation (e.g., I believe that my life's mission is to work for social change and improve people's lives); and financial sustainability (e.g., I know how to budget for a project). The response format of the instrument was Likert-type with values 1: Strongly disagree, 2: Disagree, 3: Neither agree nor disagree, 4: Agree, 5: Strongly agree. Cronbach's alpha was calculated for validation, which yielded an overall reliability of .86 for the instrument.

### ***Complex Thinking***

The purpose of the E-Complexity instrument is to measure the participants' perceived mastery of reasoning-for-complexity competency. It comprises 25 items divided into four sub-competencies: Systemic thinking (e.g., I organize information to solve a problem); Scientific thinking (e.g., I use reasoning based on scientific knowledge to make judgments about a problem); Critical thinking (e.g., I appreciate criticism in the development of projects to improve them), and Innovative thinking (e.g., I tend to evaluate with critical and innovative sense the solutions derived from a problem). This instrument has a Likert-type response format: 1: Strongly disagree, 2: Disagree, 3: Neither agree nor disagree, 4: Agree, 5: Strongly agree. It is an instrument validated theoretically and statistically by a team of experts in the field. The averages obtained for the criteria evaluated by the experts were: Clarity (3.31), Coherence (3.38), and Relevance (3.54). Based on the theoretical and content validation through expert judgment, it was determined that the e-Complexity instrument is highly valid and reliable ([Castillo-Martínez et al., 2022](#)).

The SEL4C Methodology has two validation moments, the first with a pilot test conducted in a controlled group and the second comprising a broad implementation ([Vázquez-Parra, Carlos-Arroyo & Cruz-Sandoval, 2023](#)). In both cases, it proved to be valid for developing social entrepreneurship ideas and improving the students' perceived achievement by 6% in the competencies of social entrepreneurship and complex thinking, as well as in their sub-competencies ([Vázquez-Para & Cruz-Sandoval, 2022](#)).

It should be noted that although this validation is available, this methodology is still in the process of implementation in other educational environments and realities. Up to this point, this methodology had only been applied with students from the same institution, seeking to identify how elements such as gender, age or discipline of study could influence the results. However, a pending issue during the validation process and its previous implementations was to consider participants from other institutions or even from other countries. Therefore, this work proposes its originality because it combined the validation process, considering participants from various Latin American institutions, in an intensive period (two weeks) and focused on developing ideas for Educational Innovation.

This study intends to identify the suitability of this methodology for developing educational social entrepreneurship ideas at the higher education level.

## **Methodology**

### **Participants and Procedure**

Our non-probabilistic convenience sample comprised participants in an open educational innovation course that was part of the annual meeting of the UNESCO Open Education Chair for Latin America, held from January 9-20, 2023, in Monterrey, Mexico. The objective of this course was that participants could acquire knowledge about open education and develop a proposal for open educational innovation that would be scalable in the medium term (six months to one year). To provide participants with a reliable tool for this process, we implemented the SEL4C methodology to serve as a motivational element to support them in their ideation process and provide them with valuable entrepreneurial skills for their professional futures.

The sample consisted of 38 participants from eight countries (six Latin American and two European), with representation from the five basic disciplines of the University (Humanities, Social Sciences, Health, Business, Engineering, and Arts). Demographically, the sample consisted of 12 (32%) men and 26 (68%) women, with an average age of 44 years old, the youngest person being 26, and the oldest 64.

The implementation process was carried out considering the parameters established by the methodology, i.e., each participant carried out the initial diagnosis, the nine suggested activities and the closing diagnosis. Although the work was carried out in teams, each participant was asked to take part in the reflection, with the intention of verifying that the methodology implemented gave results. It is considered that although the activities can be carried out in teams, the development and evaluation of the competencies should be done individually. The implementation was done in person, supported by a team of collaborators who were trained to implement the methodology.

### **Ethical Considerations**

Because it was a study involving people, 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 at Tecnológico de Monterrey. Both the study and the instruments applied adhered to the privacy notice ([Tecnológico de Monterrey, 2023](#)) and the ethical framework of the institution, with the approval of the institutional ethics committee.

### **Data analysis**

Regarding the analysis of the data, nonparametric multivariate descriptive analyses were considered, due to the non-normality of the data. The Mann-Whitney U test was used to analyze the differences in medians between groups, the reference value was taken as a significance



level of  $p < .005$  to establish the existence of differences in medians between the comparison groups. To analyze the relationship between the variables of interest, the nonparametric Spearman correlation coefficient was used, and a significance level of  $p < .005$  was considered to establish the presence of association between the variables analyzed. The analyses were carried out with the Statistical Package for the Social Sciences (SPSS 23) statistical software.

## Results

We analyzed the means and standard deviations of the social entrepreneurship competency measured at the beginning and end of implementing the SEL4C methodology in a group of participants in an intensive course on educational innovation. The means at the beginning and end show an improvement in each sub-competency that make up social entrepreneurship, with the leadership sub-competency showing the most increase (0.24). The overall complex thinking competency increased by 0.31 at the end of the intensive course (see Table 2 and Figure 1).

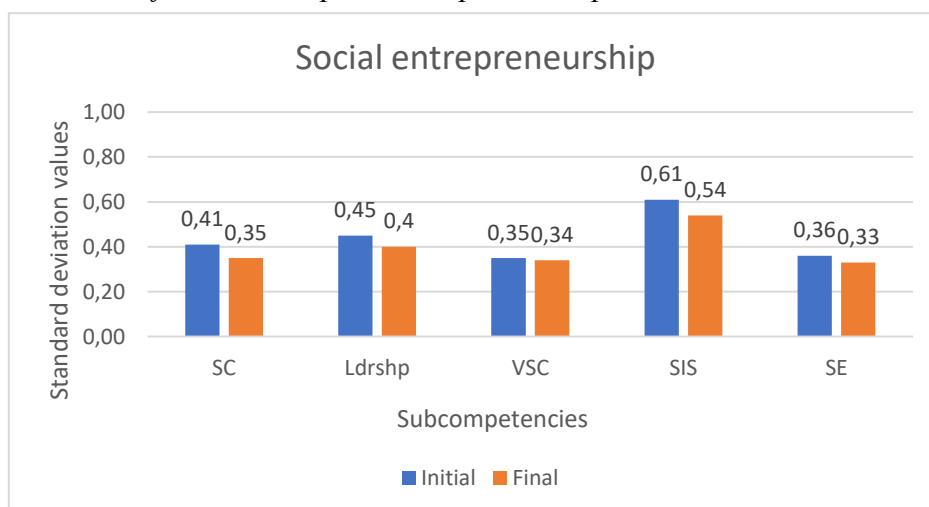
**Table 2**

*Means and standard deviations of the social entrepreneurship competency*

	Initial evaluation		Final evaluation	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Self-control	4.64	.41	4.76	.35
Leadership	4.35	.45	4.59	.40
Courage and social awareness	4.50	.35	4.73	.34
Social innovation and Sustainability	3.98	.61	4.48	.54
Social entrepreneurship	4.32	.36	4.63	.33

**Figure 1**

*Standard deviations of social entrepreneurship sub-competencies*



*Note.* SC: Self-control; Ldrshp: Leadership; VSC: Value and social Conscience, SIS: Social Innovation and Sustainability and SE: Social Entrepreneurship. This figure shows the distribution of the standard deviations of the social entrepreneurship sub-competencies.

Also, a test of differences of medians was performed to evaluate the change in the social entrepreneurship competency and sub-competencies. The results showed statistically significant differences between the medians obtained at the beginning and the end of the implementation of the SEL4C methodology (see Table 3).

**Table 3**

*Confidence calculations on the differences in medians between start and end groups for social entrepreneurship competency*

	<i>p.</i>
Self-control	.050
Leadership	.000
Courage and social awareness	.000
Social innovation and sustainability	.000
Social entrepreneurship	.000

*Note.* The significance level is .05.

A Mann-Whitney U test was performed considering the participants' gender and the social entrepreneurship sub-competencies measured at the beginning and end of the SEL4C methodology implementation. The results showed a statistically significant difference only in the sub-competency of social innovation and sustainability, with the men's means higher than women. No statistically significant differences were found in measuring the sub-competencies at the end of the methodology implementation (see Table 4).

**Table 4**

*Mann-Whitney U test for rank comparisons of gender in social entrepreneurship sub-competencies*

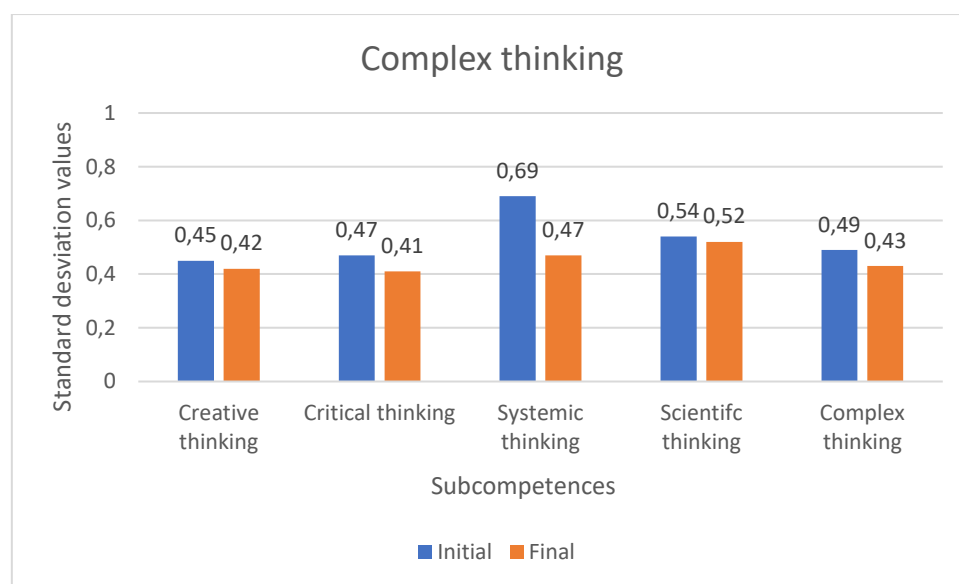
<b>Initial evaluation</b>				
	M	F	<i>U</i>	<i>p</i>
Self-control	19.7	19.4	153.5	.934
Leadership	21.5	18.5	132.0	.446
Social awareness and value	21.4	18.6	133.0	.466
Social innovation and sustainability	25.4	16.7	85.0	.025
<b>Final evaluation</b>				
	M	F	<i>U</i>	<i>p</i>
Self-control	21.8	18.4	128.0	.325
Leadership	21.0	18.8	138.0	.564
Social awareness and value	21.9	19.3	126.5	.325
Social innovation and sustainability	23.3	17.7	110.0	.141

*Note.* Mann-Whitney U test

Similarly, an analysis of means and standard deviations of the complex thinking competency showed that, like the social entrepreneurship competency, there was an increase in each sub-competency, with the least increase in the mean in scientific thinking. The overall competency improved by 0.32 at the end of the intensive course (see Table 5 and Figure 2).

**Table 5***Means and standard deviations of the complex thinking competency*

	Initial evaluation		Final evaluation	
	<i>M</i>	<i>DE</i>	<i>M</i>	<i>DE</i>
Creative thinking	4.35	.45	4.67	.42
Critical thinking	4.36	.47	4.68	.41
Systemic thinking	4.22	.69	4.55	.47
Scientific thinking	4.28	.54	4.57	.52
Complex thinking	4.30	.49	4.62	.43

**Figure 2***Standard deviations of complex thinking sub-competencies*

*Note.* The figure shows the distribution of standard deviations in the sub-competencies of complex thinking.

Similarly, a significant test of differences of means was performed to evaluate the change in the competency and sub-competencies of complex thinking. The results showed statistically significant differences between the means obtained at the beginning and the end of the implementation of the SEL4C methodology (see Table 6).

**Table 6***Statistically significant difference tests of means between the baseline and ending measurement for complex thinking competency*

	<i>p.</i>
Creative thinking	.000
Critical thinking	.000
Systemic thinking	.000
Scientific thinking	.001
Complex thinking	.000

*Note.* The significance level was .05.

**Table 7**

*Mann-Whitney U test for comparison of ranks between gender and social entrepreneurship sub-competencies*

<b>Initial evaluation</b>				
	M	F	U	p
Creative thinking	24.5	17.1	95.0	.053
Critical thinking	25.5	16.1	83.5	.021
Systemic thinking	24.8	17.0	91.5	.041
Scientific thinking	26.3	16.0	73.5	.009
<b>Final evaluation</b>				
	M	F	U	p
Creative thinking	23.2	17.1	111.0	.134
Critical thinking	22.8	17.9	115.5	.167
Systemic thinking	24.0	17.4	101.5	.079
Scientific thinking	23.7	17.5	105.5	.091

*Note.* Mann-Whitney U test

Finally, Spearman correlations between social entrepreneurship and complex thinking competencies measured at the beginning and end of applying the SEL4C methodology showed positive and statistically significant relationships, indicating the linear association among the variables analyzed (see Table 8).

**Table 8**

*Spearman correlations between social entrepreneurship and complex thinking competencies*

	1	2	3	4
1. Social entrepreneurship (initial)	-			
2. Social entrepreneurship (final)	.66**	-		
3. Complex thinking (initial)	.78**	.55**	-	
4. Complex thinking (final)	.53**	.79**	.61**	-

## Discussion

To better understand the scope of these results, they were divided to analyze the social entrepreneurship competency and its sub-competencies and then the complex thinking competency and its sub-competencies. Thus, the first finding is associated with the initial and final means of social entrepreneurship competency and its sub-competencies.

As shown in Table 2 and graphically in Figure 1, the students generally perceived improvement in the social entrepreneurship competency, which increased by 7% in its final evaluation. This aligns with the pilot test and validation of the methodology (Vázquez-Parra, Carlos-Arroyo & Cruz-Sandoval, 2023), where this competency improved by 6.2%.

As for the sub-competencies, all improved in perceived mastery; the sub-competency of Self-control had the highest improvement (4.76), followed by Awareness and Social Value (4.73). However, these sub-competencies did not necessarily indicate the best performance; although Social Innovation and Sustainability was the lowest on the scale compared to the other variables, it had the best improvement (12.6%).

Conversely, it is noteworthy that although Self-control reached the highest scale level, it had the least improvement (2.5%). As seen in Table 3, the improvements were noticeable and statistically significant in all cases.

Considering that one of the objectives of this research was to verify the reliability of the SEL4C methodology in an intensive course, we can confirm it, at least in terms of the perceived achievement of the social entrepreneurship competency and its sub-competencies. In general, the social entrepreneurship competency showed a better improvement than the validation process (7%), also seen in the Awareness and Social Value sub-competencies (which improved by only 3.7% in the validation and by 5.1% in this study). The Social Innovation and Sustainability sub-competency increased by 11.4% in the validation and 12.6% in this study. As for Self-control and Leadership, the validation yielded a better result, but less than 1%, so not significant.

It is interesting to note that there are previous studies that have analyzed how the development of methodologies focused on the entrepreneurial process can improve the perception of the participants, especially in terms of their abilities at the moment of developing an entrepreneurial idea. Fayolle, et al., (2006) propose that a methodology based on the theory of planned behavior (TPB) can improve entrepreneurial intention, providing a positive perception in young entrepreneurs. Also, Mets et al., (2013), propose the development of a methodology based on social constructivist experimentation as a proposal of the University of Tartu that seeks to encourage the desire for entrepreneurship by its students. Perez-Encinas et al. (2021), for their part, focused on the importance of methodologies that promote intergenerational entrepreneurship, especially when seeking to address needs that affect various population groups in complex environments. Although these are not the only existing studies that contribute in this sense, they are an example of the existence of methodologies such as SEL4C that demonstrate an impact not only on the process of generating entrepreneurship, but also on the development of the entrepreneurial profile and skills.

Deepening this study to include the gender variable (Table 4), we note no statistically significant difference in the improvement perceived by men and women. It is noteworthy that, although initially, a significant difference was identified in measuring the Social Innovation and Sustainability sub-competency, it disappeared once the methodology was applied. Although these results are satisfactory, they are contrary to previous studies by Pimpa (2021) and Vázquez-Parra, Amézquita-Zamora, & Ramírez-Montoya (2022), who pointed out that women tend to have a greater preference for the social aspects involved in entrepreneurial processes. However, it is important to note that the populations of these studies were university students, so elements such as age or being professionals could be a differentiating factor. Even so, this is an issue that would be relevant to investigate further to identify whether there is indeed a point at which gender ceases to be an element that has a significant impact on the perception of entrepreneurs.

Thus, as a first finding, we note that, despite being an intensive course, the methodology is valid and reliable for developing students' perceived achievement of social entrepreneurship competency and its sub-competencies, regardless of the gender of the participants.

Also, regarding the perceived achievement of the complex thinking competency, we note the improvement in the competency and its sub-competencies. Overall, the perception of the

complex thinking competency increased by 7.4%, which was 1.1% higher than in the validation process of the methodology (Table 5). As for the sub-competencies (Table 5 and Figure 2), all improved considerably, with critical thinking (4.68) and innovative or creative thinking (4.67) attaining the highest levels on the scale. However, as with the social entrepreneurship sub-competencies, although systems thinking was the lowest sub-competency on the final evaluation (4.55), it improved the most (7.8%). On the other hand, scientific thinking had a moderate final result (4.57) and demonstrated the least improvement (6.7%). As shown in Table 6, the improvement was notable and statistically significant in all cases.

Comparing with the validation process (Vázquez-Parra et al., 2023a), we can confirm that the complex thinking competency and its sub-competencies showed validated improvement in the implementation of this methodology in this intensive course. As mentioned above, the students' perceived achievement of complex thinking competency improved by 1.1% over the result of the validation process. The improvement was replicated in most of the sub-competencies: creative thinking improved by 7.2% compared to 6% in the validation process; critical thinking improved by 7.3% compared to the 5% achieved in the validation; and systemic thinking improved by 7.8% as opposed to the 5% achieved in the validation. Only scientific thinking failed to develop comparatively; it improved by 8.7% in the validation and 6.7% in this study. It was the sub-competency with the lowest scaling.

It is important to note that although the development of complex thinking competence can occur naturally in any learning process, this does not imply that there are no differences in the implementation of specific methodologies. It is possible to appreciate studies such as those of Ramírez et al. (2021,2022) and Cruz-Sandoval et al. (2023), which show how complex thinking is a competence that is not only valuable within professional training processes, but also develops in parallel to the learning process. Although, as also concluded in these studies, it is a valuable issue to identify good educational practices that give better results in the process of acquisition and scaling of this cognitive skill.

Deepening this study to include the gender variable (Table 7), we note that in its initial measurement, the perceived competency and sub-competencies showed statistically significant differences, with men showing the best results. However, after the implementation of the methodology, this gender difference was only preserved in the systemic and scientific thinking sub-competencies, although less considerably than in the initial state. This result is in line with the study by Cruz-Sandoval et al. (2023), who identified how gender is often an element that can vary the perception of complex thinking performance, widening or narrowing the gap between men and women according to the type of intervention that is carried out.

Thus, as a second finding, we note that despite being an intensive course, the methodology was valid and reliable for developing the students' perceived achievement of the complex thinking competency and its sub-competencies, improving the balance between men and women.

Next, seeking to link the results of both competencies, we performed a Spearman correlation, from which it was possible to verify the existence of a positive and significant correlation between the perceived achievement of social entrepreneurship competency and complex thinking. Thus, the third finding is that the methodology is valid for the correlated scaling of both competencies in accordance with the validation process results and previously

conducted studies (García-González & Ramírez-Montoya, 2019; García-González & Ramírez-Montoya, 2021; Vázquez-Parra et al, 2023a; Vázquez-Parra, et a., 2023b).

Finally, it can be pointed out that SEL4C is a valid methodology not only for the process of idea generation at a basic level associated with social entrepreneurship or, in the case of this group, educational entrepreneurship; it also proves to be a reliable methodology for the development of transdisciplinary competencies, particularly social entrepreneurship, and complex thinking. Although, as has been shown in this discussion, the results are, in most cases, close to conclusions that have been foreseen in previous studies, these results allow us to contribute to the study of social entrepreneurship and its relationship with complex thinking from a different and little analyzed perspective (Vázquez-Parra, Amézquita-Zamora & Ramírez-Montoya, 2022).

One of the objectives of any methodology must be to carry out tests that guarantee its validity and reliability in diverse environments and realities because it is difficult to guarantee that similar circumstances will occur in all its implementations. This is especially valuable in educational innovation, where the reality is that tools are implemented among diverse people and institutions, so it is necessary to trust that similar results can be obtained. Thus, this research aimed to add to the validation of the SEL4C methodology, which, as explained above, had only been implemented in academic contexts in semester terms.

The present study concludes that SEL4C is an ideal methodology for developing initial ideas for social entrepreneurship and impacting the acquisition and scaling of students' perceived achievement of social entrepreneurship and complex thinking competencies, regardless of the course duration. Indeed, this study seems to show that the intensive implementation of the methodology could have a better result, achieving a better perception of achievement in most indicators.

The results of this study have both practical and theoretical implications, since its findings are relevant for those interested in this methodology, as well as for any scholar of educational innovation, complex thinking and social entrepreneurship. At a theoretical level, this study allows us to advance in the frontier of knowledge of both competency training and entrepreneurship training, by showing the importance of carrying out analyses and reflections on the entrepreneurial process as a pedagogical tool, beyond its entrepreneurial contribution. Although this study is based on a specific methodology, it shows that entrepreneurship processes have an educational relevance that goes beyond the generation of enterprises, but also in the acquisition and development of relevant competencies for lifelong learning. In a practical way, the results shed light on the broad possibilities of this methodology, considering that it is still necessary to apply it in more contexts to identify if there are other competencies, besides complex thinking, that could benefit from this learning process of entrepreneurship.

It is recognized that the major limitation of this study is the small sample size of participants; however, the results are valuable and justify its eventual replication with a larger population. Something valuable derived from this research is that its results open the possibility of more significant opportunities to implement this methodology, whether for a semester or a couple of weeks, with the confidence that SEL4C will yield valid results. Studies remain to be done where the time is further reduced, or the methodology is offered in a workshop whose objective is exclusively its implementation.

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### References

- Alvi, I. (2022). Effect of Communication Strategies for Implementation of IT-based Educational Innovation During COVID-19 Pandemic on Students' Motivation, Attitude, and Intent. *IIMS Journal of Management Science*, 13(1). <https://doi.org/10.1177/0976030X211051096>
- Baena, J., Ramírez, M., Mazo, D., & López, E. (2022). Traits of Complex Thinking: A Bibliometric Review of a Disruptive Construct in Education. *Journal of Intelligence*, 10(3), 37. <https://doi.org/10.3390/jintelligence10030037>
- Brown, S. (2019). A Patterning Approach to Complexity Thinking and Understanding for Students: A Case Study. *Northeast Journal of Complex Systems (NEJCS)*, 1(1), 6. <https://doi.org/10.22191/nejcs/vol1/iss1/6>
- Castillo-Martínez, I., Ramírez-Montoya, M., & Torres-Delgado, G. (2022). Reasoning for complexity competency instrument (e-Complexity): Content validation and expert judgment. *Education in the Knowledge Society*. <https://hdl.handle.net/11285/643622>
- Cantú, V., Glasserman, L.D., & Ramírez, M. S. (2019). Comportamiento métrico sobre evaluación de la educación en emprendimiento. *Investigación bibliotecológica: archivonomía, bibliotecología e información*, 33(79), 99-117. <http://hdl.handle.net/11285/632981>
- Cheung, C., & Wong, S. (2018). Entrepreneurship education in higher education: A systematic review and research agenda. *Education and Training*, 60(9), 949-968. <https://doi.org/10.1108/ET-02-2018-0037>
- Cole, D. (2010). Building global competence: Preparing our students for a complex world. *Change: The Magazine of Higher Learning*, 42(4), 26-31.
- Cruz-Sandoval, M., Vázquez-Parra, J. C., Carlos-Arroyo, M., & Del Angel-González, M. (2023). Complex thinking and its relevance in professional training: An approach to engineering students in a mexican university. *International Journal of Engineering Pedagogy (iJEP)*, 13(3), 100-119. <https://doi.org/10.3991/ijep.v13i3.36885>
- Cruz-Sandoval, M., Vázquez-Parra, J., Carlos-Arroyo, M., & Amézquita-Zamora, J. (2023). Student perception of the level of development of complex thinking. An approach in university women in Mexico. *Journal of Latinos and Education*. <https://doi.org/10.1080/15348431.2023.2180370>
- Deboever, N., Luc, J., Nguyen, T., Estrera, A., Vaporciyan, A., Hetz, R., & Antonoff, M. (2022). Using technology to increase the reach of educational innovation: globalization of a novel departmental journal club. *Journal of the Association for Surgical Education*, 1(64). <https://doi.org/10.1007/s44186-022-00069-2>
- DeRosa, R., & Jhangiani, R. (2017). Open education and social justice. *Journal of Open Education Resources*, 4(1), 1-13. <https://doi.org/10.1177/097603>
- Drucker, J. (2021). Sustainability and complexity: Knowledge and authority in the digital humanities. *Digital Scholarship in the Humanities*, 26(2), 86-94. <https://doi.org/10.1093/lc/fqab025>

- Fayolle, A., Gailly, B., & Lassas-Clerc, N. (2006). Assessing the impact of entrepreneurship education programmes: a new methodology. *Journal of European Industrial Training*, 30(9), 701-720. <https://doi.org/10.1108/03090590610715022>
- García, F., & Lytras, M. (2019). Entrepreneurial learning and education for sustainable development. *Sustainability*, 11(19), 5494. <https://doi.org/10.3390/su11195494>
- García, F., Zangrando, V., & Colomo, R. (2019). Promoting entrepreneurship education in engineering studies through the use of open educational resources. *Education Sciences*, 9(3), 181. <https://doi.org/10.3390/educsci9030181>
- García-González, A., & Ramírez-Montoya, M. (2021). Social entrepreneurship education: changemaker training at the university. *Higher Education, Skills and Work-Based Learning*, 11(5), 1236-1251. <https://doi.org/10.1108/HESWBL-01-2021-0009>
- García-González, A., & Ramírez-Montoya, M. (2019). Higher education for social entrepreneurship in the quadruple helix framework: co-construction in open innovation. [Conference]. *TEEM'19: Proceedings of the Seventh International Conference on Technological Ecosystems for Enhancing Multiculturality*, León, Spain. <https://doi.org/10.1145/3362789.3362794>
- Khaskheli, K. (2023). *Innovation in Education. Pakistan: IGI Global*. <https://10.4018/978-1-6684-5417-6.ch009>
- Kiripi, E., Ailwei, M., & Van-Wyk, M. (2022). Exploring faculty members' views on the use of open education resources: A case of the Namibian open distance learning institutions. *International Journal of Educational Methodology*, 8(1), <https://doi.org/107-116.10.12973/ijem.8.1.107>
- Kiviniemi, U., & Kultalahti, S. (2020). Entrepreneurship education and learning-by-doing in maker education. *Technology, Pedagogy, and Education*, 29(1), 29-45. <https://doi.org/10.1080/1475939X.2019.1633692>
- Mets, T., Raudsaar, M., & Summatavet, K. (2013). Experimenting Social Constructivist Approach in Entrepreneurial Process-Based Training: Cases in Social, Creative and Technology Entrepreneurship. In: Curley, M., Formica, P. (eds) *The Experimental Nature of New Venture Creation. Innovation, Technology, and Knowledge Management*. Springer, Cham. [https://doi.org/10.1007/978-3-319-00179-1\\_11](https://doi.org/10.1007/978-3-319-00179-1_11)
- Morin, E. (1990). *Introducción al pensamiento complejo*. Gedisa.
- UN. (2022). United Nations. *Obtenido de Objetivos de Desarrollo Sostenible*. <https://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/>
- Pérez-Encinas, A., de Pablo, I., Bueno, Y., & Santos, B. (2021). Intergenerational Entrepreneurship to Foster Sustainable Development: A Methodological Training Proposal. *Sustainability* 13, 9654. <https://doi.org/10.3390/su13179654>
- Pimpa, N. (2021). Overcoming Gender Gaps in Entrepreneurship Education and Training. *Frontiers in Education*, 6, 774876. <https://doi.org/10.3389/feduc.2021.774876>
- Portuguez-Castro, M., & Gómez-Zermeño, M.G. (2020). Being an entrepreneur post-COVID-19 – resilience in times of crisis: a systematic literature review. *Journal of Entrepreneurship in Emerging Economies* [In Press]. <https://doi.org/10.1108/JEEE-07-2020-0246>
- Ramírez, M., Alvarez, I., Sanabria, J., López, E., Alonso, P., & Miranda, J. (2021). Scaling Complex Thinking for Everyone: A Conceptual and Methodological Framework. [Conference]. *TEEM'21: Ninth International Conference on Technological Ecosystems for*

- Enhancing Multiculturalism (TEEM'21)*, León, Spain.  
<https://doi.org/10.1145/3486011.3486562>
- Ramírez-Montoya, M., Castillo-Martínez, I., Sanabria, J., & Miranda, J. (2022). Complex Thinking in the Framework of Education 4.0 and Open Innovation—A Systematic Literature Review. *Journal of Open Innovation: Technology, Market and Complexity*, 8(1), 4. <https://doi.org/10.3390/joitmc8010004>
- Rodes, V., & Gewerc, A. (2023). Educational Innovation, Open Educational Resources, and Gender in Latin American Universities. *Education Sciences*, 13(1), 19. <https://doi.org/10.3390/educsci13010019>
- Siphamandla, L., & Mthethwa, L. (2022). Potential ethical problems in the creation of open educational resources through virtual spaces in academia. *Heliyon*, 8(6). <https://doi.org/10.1016/j.heliyon.2022.e09623>
- Sofyan, D., & Hafezad, K. (2022). Scientific developments in educational innovation research in Indonesia and Malaysia: a scientometric review. *Educational Innovation and Research*, 1(1), 42-51. <https://doi.org/10.31949/ijeir.v1i1.2312>
- Suárez-Brito, P., Baena-Rojas, J.J., López-Caudana, E.O., & Glasserman-Morales, L.D. (2022). Academic Literacy as a Component of Complex Thinking in Higher Education: A Scoping Review. *European Journal of Contemporary Education*, 11(3), 931-945. <http://dx.doi.org/10.13187/ejced.2022.3.931>
- Sultan, P. (2023). The Roles of Innovation, Leadership, and Governance in Higher Education for the Covid-19 Recovery: A Review. En P. Sultan, *Innovation, Leadership and Governance in Higher Education* (pp. 3-23). Springer. [https://doi.org/10.1007/978-981-19-7299-7\\_1](https://doi.org/10.1007/978-981-19-7299-7_1)
- Silva, C., & Iturra, C. (2021). A conceptual proposal and operational definitions of the cognitive processes of complex thinking. *Thinking Skills and Creativity*, 39. <https://doi.org/10.1016/j.tsc.2021.100794>
- Tecnológico de Monterrey. (2023) SEL4C Privacy Notice. <https://tec.mx/es/aviso-de-privacidad-sel4c>
- UNESCO-ICDE. (2023). *Movimiento Educativo Abierto para América Latina*. Obtenido de <https://oerunesco.tec.mx/>
- Vázquez-Parra, J. C., Alfaro-Ponce, B., Guerrero-Escamilla, J., & Morales-Maure, L. (2023). Cultural Imaginaries and Complex Thinking: Impact of Cultural Education on the Development of Perceived Achievement of Complex Thinking in Undergraduates. *Social Sciences*, 12(5), 272. <https://doi.org/10.3390/socsci12050272>
- Vázquez-Parra, J., Alonso-Galicia, P., Cruz-Sandoval, M., Suarez-Brito, P., & Carlos-Arroyo, M. (2023). Social Entrepreneurship, Complex Thinking, and Entrepreneurial Self-Efficacy: Correlational Study in a Sample of Mexican Students. *Administrative Sciences*, 13(4), 104. <https://doi.org/10.3390/admsci13040104>
- Vázquez-Parra, J.C., Amézquita-Zamora, J.A. & Ramírez-Montoya, M.S. (2022). Student perception of their knowledge of social entrepreneurship: gender gap and disciplinary analysis of an Ashoka Changemaker campus in Latin America. *Journal of Applied Research in Higher Education*, 14(3), 1224-1241. <https://doi.org/10.1108/JARHE-02-2021-0067>

- Vázquez-Parra, J., Castillo-Martínez, I., Ramírez-Montoya, M., & Millán, A. (2022). Development of the Perception of Achievement of Complex Thinking: A Disciplinary Approach in a Latin American Student Population. *Education Sciences*, 12(5), 289. <https://doi.org/10.3390/educsci12050289>
- Vázquez-Parra, J. C., Carlos-Arroyo, M., & Cruz-Sandoval, M. A. (2023). Social Entrepreneurship and Complex Thinking: Validation of SEL4C Methodology for Scaling the Perception of Achieved Competency. *Education Sciences*, 13(2), 186. <https://doi.org/10.3390/educsci13020186>
- Vázquez-Parra, J., Cruz-Sandoval, M., & Carlos-Arroyo, M. (2022). Social Entrepreneurship and Complex Thinking: A Bibliometric Study. *Sustainability*, 14(20). <https://doi.org/10.3390/su142013187>
- Vázquez-Para, J., & Cruz-Sandoval, M. (2022). *SEL4C: Social Entrepreneurship Learning 4 Complexity*. Obtenido de Repositorio Institucional del Tecnológico de Monterrey: <https://hdl.handle.net/11285/650010>