


# Open Education on Social Entrepreneurship: A Comparative Study Between Mexico and Bolivia to Scale Up Complex Thinking


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## Abstract

**Objectives:** This study examined the effectiveness of an open digital educational platform for developing complex thinking competencies through social entrepreneurship education among higher education students in Mexico and Bolivia. Specifically, it assessed changes in perceived systemic, scientific, critical, and innovative thinking and compared learning outcomes across both contexts.

**Method:** A quasi-experimental pre-post design was implemented with 601 participants (Mexico,  $n = 509$ ; Bolivia,  $n = 92$ ). Participants completed a validated 25-item, Likert-scale instrument assessing systemic, scientific, critical, and innovative thinking before and after engaging with the digital platform. Within- and between-group differences were analyzed using permutation-based statistical tests, complemented by Hedges’s  $g$  effect sizes.

**Results:** Participants in both countries showed statistically significant gains in systemic, critical, and innovative thinking. Scientific thinking improved significantly only in the Mexican sample. No significant between-country differences were found at either the pre- or post-test stage, despite demographic differences such as age.

**Conclusions:** The study proposed that digital platforms delivering social entrepreneurship content can effectively enhance complex thinking competencies across educational and cultural contexts. Findings highlighted consistent improvements irrespective of baseline competency levels or demographic differences.

**Implications for Theory and/or Practice:** Results support the use of digital platforms and Open Educational Resources in higher education as strategic tools for skill development in developing countries. Educational policymakers and curriculum designers should consider contextual adaptations of social entrepreneurship content, addressing local needs and fostering interdisciplinary, competency-based learning environments aligned with United Nations Sustainable Development Goal 4 (Quality Education).

**Keywords:** *educational innovation, complex thinking, social entrepreneurship, higher education*

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## Introduction

The Open Education movement has substantial potential for developing countries and marginalized communities and aligns with the United Nations' Sustainable Development Goal 4 (2015). By expanding access to quality education and fostering more equitable learning opportunities, Open Educational resources (OER) can help reduce barriers such as high costs and limited educational infrastructure (Oke & Fernandes, 2020). This is especially relevant in regions where educational materials are scarce or outdated, allowing learners to connect with global knowledge networks at little or no cost. OER also allow educators to adapt content to local contexts and languages, benefiting first nations communities and other culturally diverse populations (Redvers et al., 2020). In this way, Open Education can support both educational access and capacity building for sustainable development.

In line with this movement, an open digital platform was developed to strengthen complex thinking competencies (Ramírez-Montoya et al., 2022) through entrepreneurship education in three domains: social, technological, and scientific entrepreneurship. Social entrepreneurship is especially vital in this initiative, because it prepares individuals to develop innovative and sustainable responses to persistent social challenges, including poverty, unemployment, and unequal access to education and healthcare.

In developing countries, where economic instability, social inequality, and limited infrastructure often constrain traditional business models, social entrepreneurship can serve as a viable avenue for economic empowerment and social change (Suguna et al., 2024). Unlike conventional entrepreneurship, which focuses primarily on profit generation, social entrepreneurship emphasizes the creation of social value, community development, and the reduction of structural inequalities, through sustainable and innovative models. Its inclusion in educational settings is particularly significant, because it encourages locally grounded responses to social problems, rather than dependence on external aid or interventions.

Higher education institutions play an important role in preparing future professionals to engage in socially responsible entrepreneurship (García-González & Ramírez-Montoya, 2019). Incorporating social entrepreneurship into curricula may help students and lifelong learners develop competencies such as systems thinking, ethical decision making, and collaborative problem solving, which are critical for addressing economic and social development challenges (Ramírez-Montoya & González-Padrón, 2022).

During implementation, the digital platform was tested in Spanish-speaking countries to assess its educational impact and scalability. The target population included higher education students and lifelong learners, with participants such as students, educators, administrators, and activists. This diversity reflects the interdisciplinary character of social entrepreneurship, which often requires collaboration across sectors to generate sustainable change.

This study presents findings from the implementation of the platform in Mexico and Bolivia, examining its effectiveness in fostering social entrepreneurship-related competencies in these developing-country settings. The main objective was to evaluate the impact of the digital course on the development of complex thinking competencies (Montes-Martínez & Ramírez-Montoya, 2022). To do so, we assessed participants' self-perceived skill development. This research aligns with ongoing efforts to use OER and digital platforms for competency development and social entrepreneurship education (Servant-Miklos & Noordegraaf-Eelens, 2021). By addressing the growing demand for 21st-century skills, it also contributes to discussions on how digital education may help reduce economic and social divides while promoting entrepreneurial thinking in higher education (Agarwal et al., 2020; Vázquez-Parra et al., 2022).

## Literature Review

Complex thinking is increasingly recognized as a core competence in higher education, because it helps learners address uncertainty, interdependence, and contemporary global challenges (Ramírez-Montoya et al., 2022; Vázquez-Parra et al., 2024). Following Pereira Chaves (2010), it can be understood as a multidimensional construct comprising systemic, scientific, critical, and innovative thinking. Systemic thinking refers to understanding interconnections within a problem or context; scientific thinking involves empirical reasoning and evidence-based analysis; critical thinking concerns the rigorous evaluation of information and assumptions; and innovative thinking emphasizes the generation of novel and effective responses to complex problems. Together, these sub-competencies support the analysis of complex realities and the design of responses with social relevance.

Their development depends on learning experiences that expose learners to challenging situations, invite reflection, and require the integration of multiple perspectives (Montes-Martínez & Ramírez-Montoya, 2022). Because such experiences are not always available in learners' immediate contexts, educational resources and environments that introduce relevant scenarios, tools, and perspectives can play an important role in fostering these competencies (Sigahi et al., 2023). This is where Open Education becomes especially valuable, as it offers a means of expanding access to learning materials that can be used, adapted, and shared across settings.

Open Education has been positioned as a means of reducing educational gaps through broader access, inclusion, and adaptive uses of technology (Amiel, 2024; Perifanou & Economides, 2023; Rostoka et al., 2021). In general, the movement is associated with the democratization of knowledge and with learning opportunities that are more flexible, interactive, and responsive to diverse human conditions (Patiño et al., 2023; Salas Bustos, 2021). According to UNESCO recommendations, OER are materials for learning or research that are openly licensed or in the public domain, allowing users to access, use, adapt, and share them freely while crediting their creators (Salas Bustos, 2021; UNESCO, 2020). When developed collaboratively, OER can also promote exchange of practice and the development of complex cognitive skills among both educators and learners (Suárez-Brito et al., 2022).

At the same time, access alone is insufficient to produce meaningful learning outcomes. Research on OER has documented positive effects on student performance, but these effects depend on factors such as resource quality, instructional design, and learner characteristics (Hilton, 2020; Patiño et al., 2023; Román Aguilar et

al., 2023; Suárez-Brito et al., 2022). This is particularly vital when the aim is to support higher-order competencies rather than only content acquisition. Open resources are, therefore, most educationally valuable when they are embedded in purposeful learning environments, include contextualized scenarios, and are paired with activities that require analysis, reflection, and application (Mendoza Arenas et al., 2023; Hilton, 2020). Digital platforms offer one way to organize these conditions at scale.

Digital platforms have transformed education by making it possible to distribute resources widely, personalize learning experiences, and support active participation (Patiño et al., 2023). In open education contexts, they can create flexible environments that facilitate access to materials, support different learning styles, and sustain interaction with content and activities aligned with contemporary educational demands (Ramírez-Montoya & González-Padrón, 2022; Salas Bustos, 2021). The relevance of digital platforms in this study was not merely technological. Rather, the platform functioned as the delivery environment through which open resources, contextualized tasks, and structured learning sequences were brought together to support competency development.

This delivery model is particularly pertinent for social entrepreneurship education. Social entrepreneurship focuses on the development of innovative and sustainable responses to social and environmental problems (Hasibuan & Nawawi, 2023; Rodríguez-Sánchez et al., 2021). Its emphasis on social value creation, contextual problem identification, and solution design makes it especially suitable for activating complex thinking processes (Ibarra-Vazquez et al., 2023). Addressing social challenges requires learners to understand systems, examine evidence, question assumptions, and generate feasible alternatives, that is, to engage the same set of sub-competencies that define complex thinking. For this reason, social entrepreneurship is not only thematically compatible with complex thinking, but it is also a plausible pedagogical vehicle for its development.

Higher education institutions have increasingly incorporated social entrepreneurship into curricula as a way of connecting learning with community needs, sustainable development, and socially responsible innovation (García-González & Ramírez-Montoya, 2019; Ramírez-Montoya & González-Padrón, 2022). This integration can support the development of competencies related to problem solving, collaboration, ethical decision making, and systems-oriented analysis (García Alonso et al., 2020). The literature also points to the importance of assessing the effects of curricular and extracurricular initiatives aimed at developing social entrepreneurship competencies (Bodolica et al., 2021; Cantillo Campo et al., 2021; Silva-Peralta et al., 2022; Xiang et al., 2023), as well as the value of structured training models that combine experiential learning, interdisciplinary collaboration, and digital technologies (García-González et al., 2020; Hockerts, 2018; Villa Sánchez et al., 2021; Vilorio, 2017).

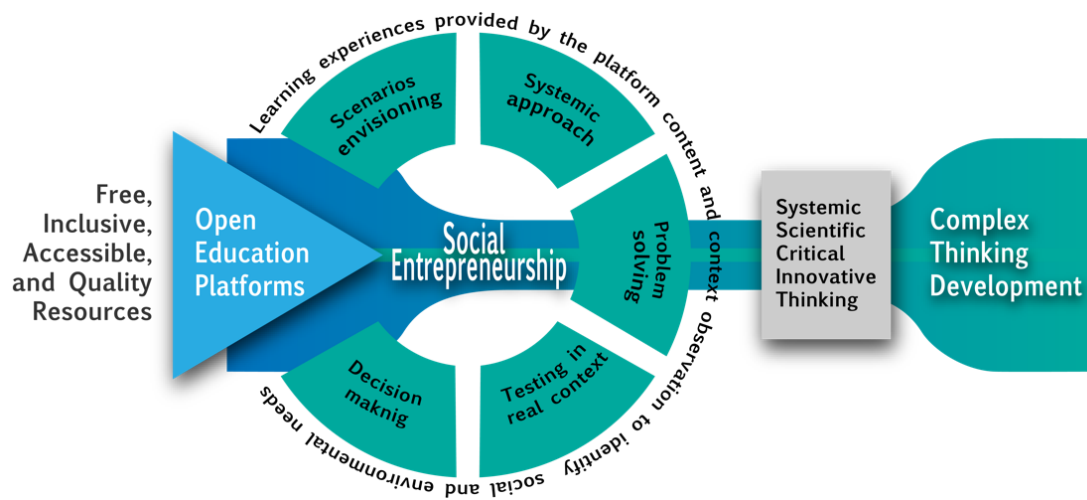
**Figure 1.** *Conceptual Framework of the Intervention*

Figure 1 illustrates the interconnection between the three core elements addressed in this study: open educational platforms, social entrepreneurship, and the development of complex thinking in individuals as an outcome of the learning experience. As a summary of the rationale for the present intervention, Open Education contributes the principles of access, adaptability, and sharing; digital platforms provide the infrastructure to organize and scale learning experiences; and social entrepreneurship offers a context in which learners must analyze complex social realities and propose informed, viable responses. From this perspective, an open digital platform centered on social entrepreneurship provides a plausible setting for supporting the development of complex thinking competencies. This study examined this possibility in participants from Mexico and Bolivia.

## Purpose of the Study

The purpose of the study was to examine the effectiveness of an open digital learning platform in enhancing complex thinking competencies through social entrepreneurship education in higher education. Specifically, this study aimed to:

- evaluate the impact of a digital education platform on the development of systemic, scientific, critical, and innovative thinking among students and educators in Mexico and Bolivia,
- compare the learning outcomes between two country contexts, identifying patterns in skill development across educational and demographic settings, and
- assess the role of digital learning environments in fostering social entrepreneurship competencies and their potential to equip students and professionals to address complex problems, such as socioeconomic innovation and sustainable development.

By addressing these objectives, this study contributes to discussions on the role of digital learning environments in higher education, particularly in relation to Open Education, complex thinking, and social entrepreneurship training.

## Methods

### Participants and Study Context

A convenience sampling strategy was used. Participants were recruited through invitations distributed by partner institutions in both countries. The sample included undergraduate students, teachers, administrators, and lifelong learners engaged in an open digital learning platform from Mexico ( $n = 509$ ; 253 women) and Bolivia ( $n = 92$ ; 48 women).

The study assessed participants' self-perceived competency levels using the eComplexity instrument (Castillo-Martínez et al., 2024). Recruitment was facilitated through partner organizations and targeted higher education institutions in both countries, as well as civil society organizations focused on youth and adult education in vulnerable communities, in order to capture a diverse participant profile. In Bolivia, this included technical, technological, and productive education programs implemented in technical institutes and alternative education centers, where participants received training across different technical fields. In Mexico, participants were drawn from higher education communities in different institutional roles and from institutions located in both urban and rural areas, spanning a broad range of socioeconomic backgrounds.

All participants provided informed consent online prior to participation. The research protocol was approved by the Institutional Research Ethics Committee of Tecnológico de Monterrey (tracking code: IFE-2024-01) with exemption validity from February 23, 2024, to February 24, 2025.

### Workshop Implementation

A series of workshops was organized in collaboration with partner institutions. Each workshop consisted of a 6-hour session delivered either face-to-face or online, depending on the conditions and availability of each institution. For example, some participants were located in remote areas with limited mobility, whereas others attended as part of a regular class session. The workshops followed the same general sequence in both countries. The first part introduced instructional scenarios designed under the Open Educational Model for Complex Thinking (Ramírez-Montoya et al., 2024). This was followed by content and activities aimed at strengthening social entrepreneurship competencies, with emphasis on practical application in real-life and educational settings. For task and activity development, the OpenEDR4C digital platform (Alvarez-Icaza et al., 2025) was used to provide content on social entrepreneurship and the sub-competencies of complex thinking. The workshops also created a collaborative learning space through discussion, reflection, and hands-on activities. All participants completed a pre-test at the beginning and a post-test at the end of the training. The implementation was designed to follow the same structure across both countries, although delivery modality varied according to local institutional conditions.

### Study Design and Instrument

A quasi-experimental pre-post design was implemented to evaluate the effect of the course on complex thinking. Participants completed the eComplexity instrument before and after the intervention. This 25-item self-report measure uses a 5-point Likert response scale ranging from 1 (no agreement) to 5 (very much in agreement) and assesses four sub-competencies of complex thinking: systemic thinking (6 items), scientific thinking (7 items), critical thinking (6 items), and innovative thinking (6 items). In this study, subscale scores were computed as the mean of the items in each dimension, with higher scores indicating greater perceived mastery.

Example items included: "I can find associations between variables, conditions, and constraints in a project, challenge, or problem I face" (systemic thinking). "I can identify the elements to formulate a research question or hypothesis" (scientific thinking). "I can identify the foundation of my own and others' judgments to

recognize false arguments” (critical thinking). “I can apply innovative solutions to various issues” (innovative thinking).

In addition to internal consistency, prior validation studies provided evidence of content and construct validity. Content validity was supported through expert review using clarity, coherence, and relevance criteria. Internal structure was supported through exploratory and confirmatory factor analyses, which upheld the four-dimensional structure of the instrument. Reported indices included KMO > .80 in an initial validation and, in a later psychometric study, KMO = .96, Bartlett’s test  $p < .05$ , and CFA fit values of CFI = .918, TLI = .909, GFI = .854, RMSEA = .052, and SRMR = .039. Reliability for the full scale was high (Cronbach’s  $\alpha = .93$ ), with acceptable-to-strong internal consistency across subscales (Castillo-Martínez et al., 2024; Vázquez-Parra et al., 2024).

## Data Analysis

All analyses were conducted using MATLAB (Krol, 2021; The MathWorks Inc., 2025). Permutation-based statistical tests were used to analyze changes in complex thinking scores within and between the two countries. Permutation-based methods are considered data-driven and distribution-free, generating an empirical null distribution of the test statistic (e.g., mean difference) by repeatedly and randomly reallocating the observed data points between groups (Good, 2005; Phipson & Smyth, 2010; Winkler et al., 2014). This approach aligns with calls from statistical educators to rethink traditional, formula-centered curricula and incorporate more conceptual, simulation-based methods that better reflect modern computational capabilities (Cobb, 2007).

Permutation tests offer several advantages. They are conceptually straightforward, rely on fewer assumptions (no need for normal distributions or equal variances), and naturally adapt to the observed data structure. Such methods are particularly suitable when sample sizes differ or when the underlying data distribution is unknown or non-normal (Winkler et al., 2014). While permutation tests can be computationally intensive, this is less of a limitation in the current times (Cobb, 2007). However, their main limitation would be some lack of flexibility to work with arbitrary experimental designs, a problem that did not affect this study given its straightforward design.

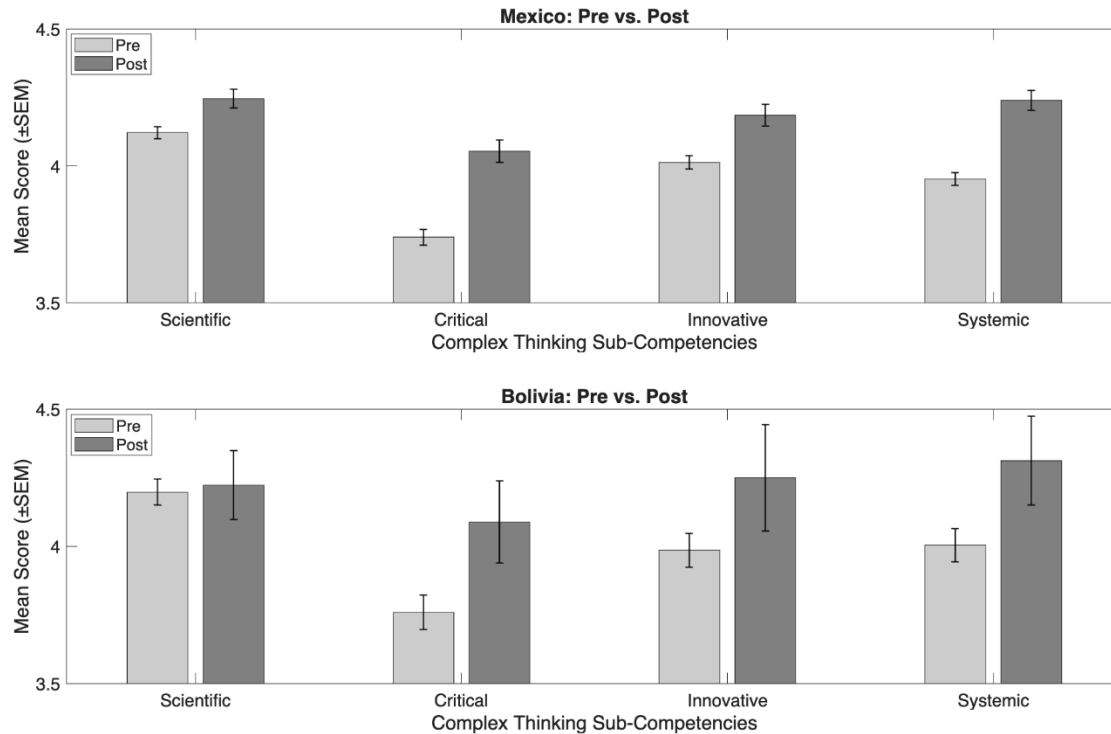
In this study, we performed 10,000 permutations to construct a stable reference distribution, allowing for more accurate  $p$ -values without relying on normality assumptions. We also reported effect sizes using Hedges’s  $g$ , a measure that includes a small-sample bias correction and is recommended for situations with unequal group sizes (Hedges, 1981). This metric provides a more accurate estimation of the magnitude of differences between groups, supporting clearer interpretation of the practical significance of the findings. We classified effect sizes using Cohen’s conventional benchmarks for standardized mean differences (small > 0.20, moderate > 0.50, large > 0.80) as a general frame of reference rather than a field-specific standard (Brydges, 2019). Lastly, a chi-square test of independence was applied to evaluate differences in gender ratios between groups.

## Results

We analyzed the results from the pre-test and post-test assessments, comparing data collected from participants in Mexico and Bolivia. There was a notable difference in sample size, with Mexico having a larger number of responses ( $n = 509$ ) compared to Bolivia ( $n = 92$ ). Despite this difference, both groups provided balanced representation in terms of gender composition, with no statistically significant differences found between the two groups according to a chi-square test ( $\chi^2(1) = 1.54, p = .663$ ). However, the age profiles differed significantly between countries, with the Mexican group being younger than the Bolivian participants (observed difference = 8.470 years;  $p < .0001$ , effect size = 0.804). Nevertheless, this demographic distinction

did not appear to significantly influence performance outcomes, as can be noted from the general trend of results seen in Figure 2 and discussed in the following section.

**Figure 2.** Mean Pre- and Post-Intervention Scores of the Four Complex Thinking Competencies for Mexico and Bolivia



*Note.* Light gray bars = pre-intervention means; dark gray bars = post-intervention means. Error bars = standard error of the mean (SEM).

### Between-Group Comparison (Mexico Versus Bolivia)

When comparing Mexico and Bolivia separately at both pre-test and post-test stages, permutation-based tests showed no statistically significant differences for any of the four complex thinking competencies (scientific, critical, innovative, and systemic). This suggests that both country groups demonstrated similar baseline and post-intervention skill levels despite their age differences.

### Within-Group Comparison (Pre- Versus Post-Test)

Permutation-based tests revealed statistically significant improvements in complex thinking competencies within both Mexico and Bolivia, although the pattern of gains varied slightly:

- Mexican participants exhibited significant post-test improvements across all four sub-competencies (systemic, scientific, critical, and innovative thinking), and
- Bolivian participants demonstrated gains in three of the four sub-competencies (systemic, critical, and innovative thinking) but not in scientific thinking.

Table 1 presents the observed differences, permutation-based  $p$ -values, and effect sizes (Hedges's  $g$ ) for each sub-competency.

**Table 1.** Results of Permutation Tests With Effect Sizes (Hedges's  $g$ ) for Within-Group Complex Thinking Competencies (CTT), by Country

CTT	Country	Pre mean (SD)	Post mean (SD)	Observed difference	$p$ -value	Effect size
Scientific	Mexico	4.12 (0.51)	4.25 (0.59)	0.124	0.001	0.230
	Bolivia	4.20 (0.46)	4.22 (0.50)	0.026	0.423	0.056
Critical	Mexico	3.74 (0.64)	4.05 (0.70)	0.314	0.0001	0.472
	Bolivia	3.76 (0.60)	4.09 (0.60)	0.330	0.021	0.547
Innovative	Mexico	4.01 (0.56)	4.19 (0.67)	0.172	0.0003	0.286
	Bolivia	3.99 (0.59)	4.25 (0.77)	0.264	0.049	0.424
Systemic	Mexico	3.95 (0.52)	4.24 (0.62)	0.288	0.0001	0.515
	Bolivia	4.01 (0.58)	4.31 (0.65)	0.307	0.027	0.520

Note. Mexico  $n$ -size = 509; Bolivia  $n$ -size = 92.

## Key Findings

Permutation analyses showed within-group gains in most complex thinking competencies after the course, although the pattern differed by country. In Mexico, all four competencies increased significantly from pre-test to post-test. Observed differences ranged from 0.124 in scientific thinking to 0.314 in critical thinking, with effect sizes from  $g = 0.230$  to  $g = 0.515$ . Using conventional benchmarks for standardized mean differences, effects were small for scientific ( $g = 0.230$ ) and innovative thinking ( $g = 0.286$ ) and moderate for critical ( $g = 0.472$ ) and systemic thinking ( $g = 0.515$ ).

In Bolivia, statistically significant gains were found in critical, innovative, and systemic thinking, whereas scientific thinking showed a small, non-significant change ( $p = 0.423$ ,  $g = 0.056$ ). For the significant results, effect sizes were moderate in critical ( $g = 0.547$ ), innovative ( $g = 0.424$ ), and systemic thinking ( $g = 0.520$ ), with observed differences ranging from 0.264 to 0.330.

Overall, the course was associated with gains in complex thinking competencies in both samples, but with different profiles. Mexico showed improvement across all four competencies, whereas Bolivia showed gains in three. Across countries, the largest effects were concentrated in critical and systemic thinking, while scientific thinking showed the weakest change, especially in Bolivia. This pattern suggests that the intervention may have been more effective in strengthening competencies related to analysis, judgment, and understanding interrelations than those more specifically associated with scientific thinking.

The absence of statistically significant between-group differences indicates broadly comparable outcomes across the two contexts, despite differences in participant characteristics such as age. At the same time, variation in the within-group patterns suggests that some competencies may have been more sensitive than others to baseline preparation, engagement with the course activities, or the extent to which they were directly activated by the learning tasks.

## Discussion

This study explored the use of an open digital learning platform to develop complex thinking competencies through social entrepreneurship education in higher education contexts in Mexico and Bolivia. The results indicate meaningful gains in perceived competency among participants from both countries, although with some variation across sub-competencies. In particular, both Mexican and Bolivian participants improved significantly in systemic, critical, and innovative thinking after engaging with the platform, whereas Bolivian participants did not show statistically significant improvement in scientific thinking.

These findings can be interpreted in light of prior work on Open Education and social entrepreneurship education. Research on OER and digital learning environments has shown that their educational value depends not only on access, but also on the extent to which resources are embedded in structured learning experiences that promote reflection, contextualization, and active engagement (Hilton, 2020; Patiño et al., 2023). In parallel, social entrepreneurship education has been described as a suitable context for developing competencies related to problem solving, collaboration, ethical decision making, and systems-oriented analysis, particularly when learning activities are connected to real social needs and solution design processes (Ibarra-Vazquez et al., 2023; Ramírez-Montoya & González-Padrón, 2022). From this perspective, the gains observed in systemic, critical, and innovative thinking are consistent with the instructional logic of the intervention: an open digital platform that combined accessible resources with applied tasks centered on socially relevant problems.

The absence of significant differences between Mexico and Bolivia at both pre- and post-test stages suggests that the platform's effects were broadly comparable across the two contexts, despite demographic differences such as age. The lack of improvement in scientific thinking among Bolivian participants may reflect a closer alignment of the intervention with critical, systemic, and innovative thinking than with the more specific processes involved in scientific thinking. As García-González and Ramírez-Montoya (2019) and Ramírez-Montoya and González-Padrón (2022) note, entrepreneurship-oriented learning is strengthened when activities are connected to real contexts and cross-sector problem solving. In this case, the workshop tasks may have more directly activated analysis, reflection, and solution generation around social problems than the evidence-based inquiry processes captured by the scientific thinking dimension. A related possibility is that the younger Mexican sample had more recent exposure to formal scientific training, making this dimension more responsive to the intervention. This interpretation is also consistent with Hilton's (2020) argument that the effects of OER depend not only on access, but also on how content interacts with participants' prior preparation and the specific conditions of implementation.

The effect sizes add nuance to this pattern. In both countries, the largest gains were found in critical and systemic thinking, with effects in the moderate range, whereas gains in scientific and innovative thinking were smaller in Mexico and scientific thinking did not improve significantly in Bolivia. This distribution is consistent with the structure of the intervention. Because the learning activities were centered on identifying social problems, examining their broader implications, and proposing responses, they may have more directly engaged processes related to analysis, judgment, and the understanding of interconnections than those more specifically associated with scientific thinking. From an applied perspective, these results remain relevant, as even small to moderate effects can represent meaningful gains in brief educational interventions delivered under heterogeneous, real-world conditions, where effects are often more modest than in tightly controlled studies (Kraft, 2020).

At a theoretical level, the findings support literature that positions OER and digital learning environments as meaningful vehicles for the development of complex thinking and entrepreneurship-related competencies when they are paired with structured and contextually relevant learning experiences. In this case, integrating social entrepreneurship into the educational design appears to have provided a suitable context for engaging systems thinking, ethical judgment, and collaborative problem solving, in line with García-González and Ramírez-Montoya (2019). The findings also support the view that digital learning environments can

contribute to capacity building when their design is responsive to the needs and conditions of specific learner groups (Ibarra-Vazquez et al., 2023).

From a practical standpoint, the results point to the value of digital interventions that are both structured and sensitive to local educational conditions. Institutions seeking to strengthen complex thinking and social entrepreneurship competencies through digital education should consider adapting content, examples, and instructional strategies to the characteristics of their learners and settings. In this sense, the results also suggest that open education initiatives can extend access to relevant learning opportunities in underserved contexts, provided that implementation is attentive to contextual differences that may shape how participants engage with the intervention.

Also from a practical standpoint, the findings support the value of well-structured digital interventions for fostering complex thinking and social entrepreneurship-related competencies across diverse educational settings. The overall pattern of gains suggests that open digital resources can support meaningful learning even when implemented under heterogeneous institutional conditions. At the same time, the variation across sub-competencies indicates that future implementations could be strengthened by attending more closely to local conditions and participant characteristics. In this sense, the study also points to the potential of open education initiatives to expand access to quality learning opportunities, particularly in underserved regions.

A further contribution of the study lies in its use of permutation-based statistical tests. Educational research often relies on parametric procedures that assume normality and homogeneity of variance, whereas the present analysis adopted an approach better suited to data with unequal sample sizes and uncertain distributional properties (Cobb, 2007; Phipson & Smyth, 2010; Winkler et al., 2014). In this respect, the study offers a methodologically coherent way to examine educational intervention effects under conditions that are common in applied settings but not always well served by conventional inferential techniques.

## **Implications**

This study has practical implications for educational practitioners and policymakers.

First, the results support the use of open digital platforms as a feasible means of fostering complex thinking competencies through social entrepreneurship education across diverse educational contexts. For higher education institutions, this suggests the value of investing in scalable digital interventions that connect entrepreneurship training with socially relevant problem solving. In developing-country contexts, this connection may be especially important, as it can bring academic learning into closer relation with community needs and civic engagement.

Second, the variability in initial competency levels and the differences observed across sub-competencies indicate that implementation should remain attentive to learner characteristics and institutional conditions. Rather than assuming uniform effects across settings, educators and curriculum developers should consider how examples, tasks, and support structures can be adjusted to improve relevance and engagement within local contexts.

Third, in the Latin American context, these findings point to the value of integrating social entrepreneurship more deliberately into curricular and cocurricular structures. Embedding this type of training within higher education programs may help link students' academic development with community-based problem identification and solution design. This could strengthen the social role of universities not only as sites of knowledge production, but also as institutions that contribute to local innovation and public engagement.

Finally, the results suggest that digital learning environments can serve as a meaningful mechanism for expanding access to learning opportunities related to social innovation and sustainable development. When supported by coherent instructional design, such platforms may help higher education institutions extend competency-based training beyond traditional classroom settings, including in contexts where educational opportunities are more limited.

## Limitations

Despite these promising findings, several limitations should be acknowledged. First, the study relied on a nonrandom convenience sample, and the substantially smaller Bolivian sample compared to the Mexican sample may limit generalizability, even though permutation tests and Hedges's  $g$  were used to support more robust estimation under unequal group sizes.

Second, the outcomes were based on self-reported perceived competencies, which may not fully reflect actual skill development. Self-assessments may also be influenced by response tendencies such as social desirability, as well as by contextual factors affecting how participants interpret and evaluate their own learning. Relatedly, because no performance-based measures were included, the study cannot determine the extent to which perceived gains corresponded to demonstrable changes in competency.

Finally, although the intervention followed the same general structure in both countries, variation in institutional conditions, delivery modality, and participants' familiarity with digital learning environments may also have influenced the observed outcomes. Future research would benefit from incorporating performance-based assessments, more balanced samples, and longitudinal designs to examine the stability of these effects over time.

## Conclusions

This study examined the use of an open digital learning platform to support the development of complex thinking competencies through social entrepreneurship education in higher education contexts in Mexico and Bolivia. Pre-test and post-test results indicated significant gains in participants' perceived competencies in both countries, although the pattern of improvement varied across sub-competencies.

Overall, the findings suggest that open digital learning environments centered on social entrepreneurship can support the development of complex thinking in higher education, particularly in contexts marked by socioeconomic and educational challenges. The results were more consistent for critical, systemic, and innovative thinking, while scientific thinking showed a less uniform pattern across countries. This indicates that such interventions may be especially suited to competencies linked to analysis, reflection, and response to socially relevant problems.

These findings should be interpreted in light of the study's reliance on self-perceived competencies and its nonrandom, unevenly distributed sample. Even so, the study contributes evidence on the educational potential of open and scalable digital interventions in Latin American contexts and supports further attention to how social entrepreneurship can be integrated into higher education teaching and curriculum design.

Future research should examine the stability of these effects over time, incorporate performance-based measures alongside self-report data, and further explore how participant characteristics and implementation conditions shape competency development across settings.

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