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# Open Education on Social Entrepreneurship: A comparative study between Mexico and Bolivia to Scale up Complex Thinkings

## Abstract

### Objectives:

This study aimed to evaluate the effectiveness of an open digital educational platform in developing complex thinking competencies through social entrepreneurship education among higher education participants from Mexico and Bolivia. Specifically, the research assessed changes in participants' perceived systemic, scientific, critical, and innovative thinking competencies, comparing learning outcomes between two distinct country 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 measuring systemic, scientific, critical, and innovative thinking before and after engaging with the digital platform. Permutation-based statistical tests assessed within- and between-group differences, complemented by effect size calculations (Hedges' g).

### Results:

Both Mexican and Bolivian participants showed statistically significant gains in systemic, critical, and innovative thinking. However, only Mexican participants showed significant improvement in scientific thinking. No significant differences emerged between countries at either pre- or post-intervention stages, despite demographic differences such as age disparities between groups.

### Conclusions:

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

### Implication for Theory and/or Practice:

Results support leveraging 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 Sustainable Development Goal 4 (Quality Education).

**Keywords:** Educational Innovation; Complex Thinking; Social Entrepreneurship; Higher Education

**Date submitted:** 2025-03-11

# Open Education on Social Entrepreneurship: A comparative study between Mexico and Bolivia to Scale up Complex Thinking

## Introduction

The Open Education movement has significant transformative potential for developing countries and marginalized communities, aligning with Sustainable Development Goal 4 (SDG4) (United Nations, 2015). By democratizing access to quality education and fostering equitable learning opportunities, open educational resources (OERs) enable individuals in underserved regions to overcome traditional barriers such as high costs and limited educational infrastructure (Oke & Fernandes, 2020). This accessibility is particularly crucial in regions where educational materials are scarce or outdated, allowing learners to engage with global knowledge networks at little or no cost. Additionally, the adaptability of OERs empowers educators to customize content to local contexts and languages, benefiting first nations communities and other culturally diverse populations (Redvers et al., 2020). Consequently, Open Education not only expands access but also contributes to capacity building and sustainable development through education.

In line with this movement, an open digital platform was developed as a digital educational resource designed to enhance complex thinking competencies (Ramírez-Montoya et al., 2022) through entrepreneurship education in three key domains: social, technological, and scientific entrepreneurship. Social entrepreneurship, in particular, is a critical component of this initiative, as it equips individuals with the knowledge and skills necessary to develop innovative, sustainable solutions to pressing societal challenges, including poverty, unemployment, and access to education and healthcare.

In developing countries, where economic instability, social inequality, and lack of infrastructure often hinder traditional business models, social entrepreneurship serves as a viable alternative to drive economic empowerment and social transformation (Suguna et al., 2024). Unlike conventional entrepreneurship, which focuses primarily on profit generation, social entrepreneurship emphasizes creating social value, fostering community development, and addressing structural inequalities through innovative, sustainable business models. Teaching social entrepreneurship in these contexts is particularly relevant because it encourages grassroots innovation, where individuals and communities can develop locally tailored solutions rather than relying solely on external aid or interventions.

Moreover, higher education institutions play a fundamental role in preparing future professionals to engage with socially responsible entrepreneurship (García-González & Ramírez-Montoya, 2019). By incorporating social entrepreneurship into educational curricula, students and lifelong learners may develop critical competencies such as systems thinking, ethical decision-making, and collaborative problem-solving, which are essential for navigating the complexities of economic and social development (Ramírez-Montoya & González-Padrón, 2021).

During its implementation phase, the digital platform was tested across various Spanish-speaking countries to assess its educational impact and scalability. The target population included higher education students and lifelong learners, encompassing a diverse range of participants, such as students, educators, administrators, and activists. This diversity reflects the interdisciplinary nature of social entrepreneurship, which requires collaboration across multiple sectors to drive meaningful and sustainable change.

This study presents findings from the implementation of a digital platform in Mexico and Bolivia, examining its effectiveness in fostering social entrepreneurship skills in such developing countries. The core objective is to evaluate the impact of the digital course on the development of complex thinking competencies (Montes-Martínez & Ramírez-Montoya, 2022). We thus assessed participants' self-perceived skill development. This research aligns with ongoing efforts to leverage OERs and digital platforms for workplace competency training and social entrepreneurship education (Servant-Miklos & Noordeggraaf-Eelens, 2021). Also, by addressing the growing demand for 21st-century skills, this study contributes to discussions on how digital education can bridge economic and social divides while promoting entrepreneurial thinking in higher education (Agarwal et al., 2020; Vázquez-Parra et al., 2022).

## Literature Review

The ability to engage in complex thinking is increasingly recognized as a fundamental skill in higher education, equipping learners to navigate uncertainty and address global challenges (Ramírez-Montoya et al., 2022; Vázquez-Parra et al., 2024). Complex thinking (Pereira Chaves, 2010) is a multidimensional construct that integrates several key competencies essential for addressing modern challenges. The associated sub-competencies are: systemic thinking, the ability to understand and analyze interconnections within systems to address problems holistically; scientific thinking, which involves applying empirical reasoning, evidence-based analysis, and logical deduction to explore and solve problems; critical thinking, the capacity to evaluate information rigorously, question assumptions, and identify biases; and innovative thinking, characterized by generating creative, novel, and effective solutions to complex problems. These competencies together equip individuals to navigate uncertainty and address the challenges of a rapidly changing world and allow them to integrate interdisciplinary capacities to find solutions to problems in local and global contexts.

### Open Education

Open education is a novel resource to bridge some educational gaps existing around the world. The advancement of information and communication technologies requires a transdisciplinary approach to develop an educational and scientific environment based on the modernized principles of open education (Rostoka et al., 2021). In this sense, it seeks to facilitate universal access to education, promoting inclusion, equity and the use of technologies in an adaptive and sustainable way (Amiel, 2024; Perifanou & Economides, 2023). This approach fosters the dissemination of knowledge, facilitates adaptive and interactive learning experiences, and prepares students to face today's challenges, equipping them with the necessary skills for a world in constant technological change (Patiño et al., 2023).

For its part, the open education movement is characterized by the democratization of knowledge (Salas Bustos, 2020). Therefore, the academic community is required to build freely available educational resources as Open Educational Resources (OER), according to UNESCO recommendations (Salas Bustos, 2020; UNESCO, 2020). These resources are educational materials under open licenses that anyone can access, use, modify and share freely (Perifanou & Economides, 2023). OER projects encourage collaboration and lead to the development of complex cognitive skills (Suárez-Brito et al., 2022). In this way, OER not only increases access to learning, but also foster a culture of innovation and constant development in education.

Research has been concerned with whether OER has a positive impact on learning performance (Patiño et al., 2023; Román Aguilar et al., 2023; Suárez-Brito et al., 2022). It should be understood that improved learning achievement depends not only on access to OER, but also on their quality, instruction and individual learner factors (Hilton, 2020). It is also recommended to use standardized instruments when measuring learning performance using OER (Hilton, 2020). This collaborative approach in open education acts as a bridge between traditional and modern educational practices, fostering a culture of knowledge sharing and mutual growth (Arenas et al., 2023). The integration of technology in open education enables future educational models to be inclusive and dynamic, linking, for example, to the context of social entrepreneurship in education.

### Social Entrepreneurship

Social entrepreneurship is a high-impact approach to address societal challenges through innovative and sustainable solutions (Hasibuan & Nawawi, 2023; Rodríguez-Sánchez et al., 2021). At its core, social entrepreneurship fosters social value creation, that is, using innovative strategies to tackle community and global issues; and economic, social, and environmental impact via addressing complex societal challenges with sustainable solutions (Ibarra-Vazquez et al., 2023).

Ashoka has been one of the pioneering organizations in advancing social entrepreneurship education within universities, fostering a culture of innovation and social impact through structured training programs (<https://www.ashoka.org/en-us/focus/social-entrepreneurship>). The integration of social entrepreneurship into university curricula plays a crucial role in developing complex thinking and problem-solving skills, which are essential for designing and implementing effective solutions that address societal challenges (García Alonso et al., 2020). Beyond formal education, fostering links between academia, industry, and civil society is a strategic approach to training professionals who can contribute to sustainable development through entrepreneurial initiatives (García-González & Ramírez-Montoya, 2019; Ramírez-Montoya & González-Padrón, 2021).

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A growing body of research underscores the need to assess the impact of both curricular (Cantillo Campo et al., 2021; Xiang et al., 2023) and extracurricular (Bodolica et al., 2021; Silva-Peralta et al., 2022) programs that seek to instill social entrepreneurship competencies. Some studies advocate for integrated approaches, combining both formal and informal learning experiences to cultivate an entrepreneurial mindset (Hockerts, 2018). Efforts to develop validated training models have focused on identifying key competencies essential for the success of social entrepreneurs (García-González et al., 2020; Villa Sánchez et al., 2021; Viloría, 2017).

By addressing social and environmental challenges, social entrepreneurship education not only contributes to economic sustainability but also aligns with broader Sustainable Development Goals (SDGs). Thus, institutions should adopt structured training models that incorporate experiential learning, interdisciplinary collaboration, and digital technologies to enhance entrepreneurial skills and promote innovation-driven social change (García-González & Ramírez-Montoya, 2019; Ramírez-Montoya & González-Padrón, 2021).

## 1 Digital platforms

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Digital platforms provide an opportunity to scale up the dissemination of knowledge, resources and essential support networks for social entrepreneurs (Guatemala Mariano et al., 2023). These platforms have transformed the education landscape by providing innovative solutions for learning and these ventures. Consequently, their integration enables personalized learning experiences and fosters active engagement of learners (Patiño et al., 2023) along with the competences that integrate their use (Ramírez-Montoya & González-Padrón, 2021). These platforms also offer tools adapted to different learning styles, enhancing education and creating an inclusive and flexible environment that follows the principles of open education.

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In the field of social entrepreneurship, digital platforms are essential to design effective strategies and reach a wider audience (Ibarra-Vazquez et al., 2023). These platforms facilitate collaboration, resource sharing and community building, which are vital for the success of social enterprises. The use of digital platforms in social entrepreneurship improves operational efficiency and amplifies impact, facilitating the resolution of complex social problems (Valadés García, 2023). In short, these digital tools become strategic allies to enhance the innovation and sustainability of social initiatives.

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Digital platforms have become relevant within the educational environment (Ramírez-Montoya & González-Padrón, 2021; Salas Bustos, 2020) and that together with open education and social entrepreneurship creates a powerful ecosystem for innovation and social change. Thanks to digital technologies, educators and entrepreneurs can effectively collaborate, share knowledge and develop scalable solutions to global problems where a culture of continuous learning and adaptation is fostered (Patiño et al., 2023). Consequently, the connectivity and accessibility offered by these open education platforms highlights their collective potential to drive their impact on social entrepreneurship.

## Purpose of the study

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The purpose of this study is to examine the effectiveness of an open digital learning platform in enhancing complex thinking competencies through social entrepreneurship education in higher education. Specifically, this research aims 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 diverse educational and demographic settings.
- Assess the role of digital learning environments in fostering social entrepreneurship skills, exploring their potential to equip students and professionals with competencies to deal with complex problems such as socioeconomic innovation and sustainable development.

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By investigating these objectives, this study contributes to ongoing discussions on the role of digital platforms in higher education, highlighting the intersection between Open Education, complex thinking, and social entrepreneurship training.

## Method

### Participants and Study Context

This study involved participants such as undergraduate students, teachers, administrators, and lifelong learners engaged in an open digital learning platform, from two countries: Mexico (n = 509, 253 females), and Bolivia (n = 92, 48 females).

The study aimed to assess participants' self-perceived performance levels using the *[Hidden for blind review]* instrument. To ensure diverse representation, recruitment targeted higher education institutions (public and private) in Mexico and Bolivia, as well as civil society organizations focused on youth and adult education in vulnerable communities. In Bolivia, this included **Technical, Technological, and Productive Education Programs implemented in Technical Institutes and Alternative Education Centers, where professionals receive training across various technical disciplines.** All participants provided informed consent before participating, which was obtained via the following link: *[Hidden for blind review]*. **The research protocol was approved by the Institutional Research Ethics Committee of *[Hidden for blind review]*.**

### Workshop Implementation

A series of **face-to-face and virtual workshops were organized in collaboration with partner institutions.** The workshops introduced content designed to strengthen scientific, technological, and social entrepreneurship competencies while emphasizing practical applications in the classroom. The objective was to cultivate entrepreneurship skills by enhancing complex thinking competencies. The workshops offered instructional scenarios that enhance learning experiences **using the Open Educational Model for Complex Thinking.** Workshops provided a collaborative learning space, facilitating knowledge exchange, discussions, reflections, and hands-on activities. To evaluate learning outcomes, all participants completed **a pre-test at the beginning and a post-test at the end of the training.**

### Study Design and Instrument

**A quasi-experimental pre-post design was implemented to evaluate the effect of the course on complex thinking.** Participants completed **a 5-point Likert-scale assessment before and after the intervention.** The assessment measured four dimensions of complex thinking: **Scientific thinking, Critical thinking, Innovative thinking, and Systemic thinking.**

The assessment instrument consisted of 25 items designed to evaluate **the four sub-competencies of complex thinking.** Its psychometric validity was supported by a KMO index  $> 0.80$  ( $p < 0.05$ ) and a **Cronbach's Alpha of 0.93,** ensuring high internal consistency. McDonald's Omega further confirmed the instrument's reliability, demonstrating that each sub-competency was distinct but collectively contributed to an overall measure of complex thinking *[Hidden for blind review]*.

### Data Analysis

All analyses were conducted using MATLAB (MathWorks, 2022). 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).

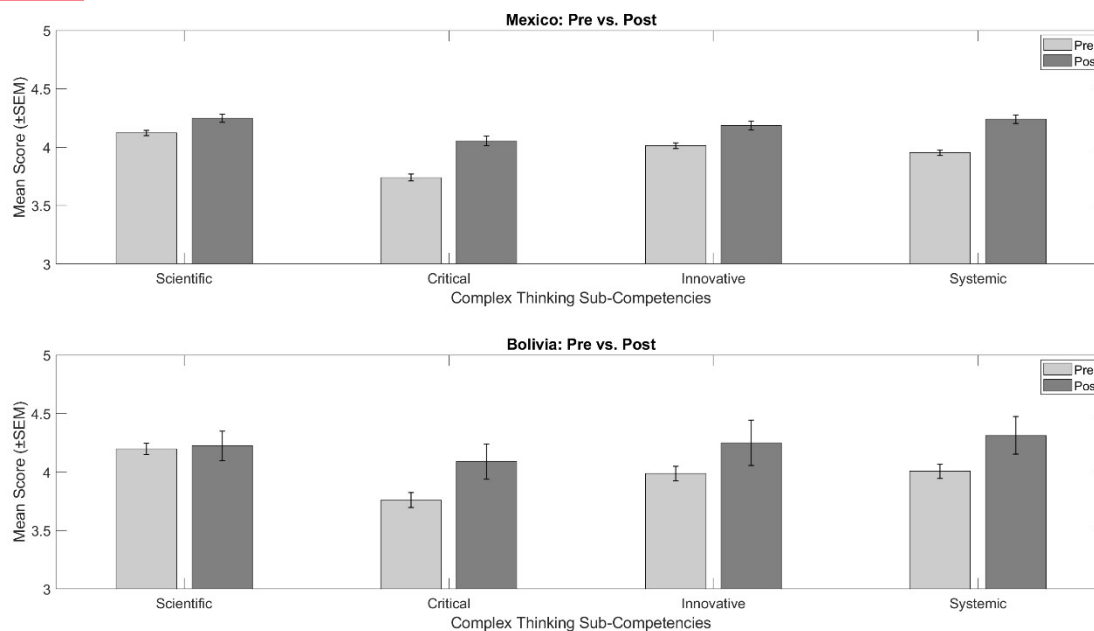
Permutation tests offer several advantages. They are conceptually straightforward, rely on fewer assumptions (no need for normal distributions or equal variances), and naturally adapt to the observed data structure. Such methods are particularly suitable when sample sizes differ or when the underlying 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 does 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' *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. Lastly, a Chi-square test of independence was applied to evaluate differences in gender ratios between groups.

## Results

The results from the pre-test and post-test assessments were analyzed, 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 1 (see also the following section).

**Figure 1.** Mean pre- and post-intervention scores of the four complex thinking competencies for Mexico (upper panel) and Bolivia (lower panel). Light gray bars represent pre-intervention means, dark gray bars represent post-intervention means. Error bars indicate the standard error of the mean (SEM).



### Between-Group Comparison (Mexico vs. 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 vs. 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).

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' g) for each sub-competency.

**Table 1.** Results of Permutation Tests with Effect Sizes (Hedges' g) for the Within-Group Complex Thinking Competencies by Country.

Complex thinking competency	Country	Observed Difference	p-value	Effect Size
<i>Scientific</i>	<i>Mexico</i>	0.124	0.001	0.230
	<i>Bolivia</i>	0.026	0.423	0.056
<i>Critical</i>	<i>Mexico</i>	0.314	0.0001	0.472
	<i>Bolivia</i>	0.330	0.021	0.547
<i>Innovative</i>	<i>Mexico</i>	0.172	0.0003	0.286
	<i>Bolivia</i>	0.264	0.049	0.424
<i>Systemic</i>	<i>Mexico</i>	0.288	0.0001	0.515
	<i>Bolivia</i>	0.307	0.027	0.520

## Key Findings

The absence of significant between-group differences, despite age disparities, suggests both groups benefited similarly from the digital learning intervention. However, the broader improvements observed within Mexico's group across all sub-competencies highlight a consistent educational benefit, contrasting with Bolivia's slightly more selective competency gains, whose lack of improvement in scientific thinking suggests potential differences in prior knowledge or engagement with the course content.

Effect sizes (Hedges' g) suggest moderate size improvements (.230-.547) across all significant comparisons. Such findings underscore the effectiveness of the digital course in enhancing **complex thinking competencies through social entrepreneurship** education in diverse contexts, regardless of age variations.

## 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 variations in specific sub-competencies. Particularly, both Mexican and Bolivian participants improved significantly **in systemic, critical, and innovative thinking** after engaging with the platform. However, Bolivian participants did not report **statistically significant improvements in scientific thinking**.

## Integration into the Literature

Such findings align with existing literature emphasizing the transformative potential of digital educational platforms, which provide flexible learning environments capable of enhancing cognitive skills crucial to contemporary societal and economic challenges (Patiño et al., 2023; Valadés García, 2023).

The absence of significant differences between Mexico and Bolivia at both pre- and post-test stages suggests that the platform's impact transcends demographic variations such as age differences, thereby underscoring its cross-cultural educational potential. Moreover, the lack of improvement in scientific

thinking for Bolivian participants possibly reflects distinct educational backgrounds or digital literacy levels (Hilton, 2020).

In terms of theoretical implications, the study contributes to ongoing literature highlighting the critical role of open educational resources in fostering complex thinking and entrepreneurial competencies essential for social and economic advancement in developing regions. Integrating social entrepreneurship into educational curricula equips learners with essential competencies such as systems thinking, ethical decision-making, and collaborative problem-solving (García-González & Ramírez-Montoya, 2019). Moreover, the findings support the notion that digital learning environments, when well-designed and contextually adapted, offer powerful vehicles for capacity building, thereby contributing effectively to Sustainable Development Goal 4 (Quality Education).

From a practical standpoint, these findings underscore the importance of context-sensitive and well-structured digital interventions that align with participants' educational and cultural realities. Educational institutions aiming to enhance the effectiveness of digital learning experiences should consider adapting content and instructional strategies to local conditions, thus increasing relevance and impact. Moreover, the success of the digital platform in fostering significant self-perceived gains underscores the potential for scaling open education initiatives to promote equitable access to quality education, particularly in underserved regions.

An additional contribution of this study to the existing literature lies in the methodological choice of using permutation-based statistical tests. While traditional educational research often relies on parametric methods that assume normality and homogeneity of variance, contrasting the data against a template distribution, this study instead aligns with emerging voices advocating for innovative, data-driven statistical techniques that better match contemporary computational capacities (Cobb, 2007; Winkler et al., 2014). Such an approach can accommodate diverse sources of data with unequal sample sizes or uncertain distributions (Phipson & Smyth, 2010), thus in this study by offering a refreshing perspective on analyzing an educational intervention aimed at social entrepreneurship and complex skill development.

### Limitations of the study

Despite these promising findings, certain limitations should be acknowledged. The reliance on self-reported assessments introduces a potential bias, as perceptions might not fully reflect actual skill development. Future research could benefit from triangulating self-perceptions with performance-based measures and a control group to provide a more comprehensive assessment of competency gains. Additionally, the significantly smaller Bolivian sample size compared to Mexico introduces some imbalance, which, although addressed through robust statistical methods (e.g., permutation tests and Hedges' g effect sizes), may still affect generalizability. Further studies with larger, evenly distributed samples could help confirm these findings. Also, future research should employ longitudinal designs to assess the long-term effectiveness and sustainability of competency gains.

### Implications for Theory and/or Practice

This study holds several practical implications for both educational practitioners and policymakers. Firstly, the apparent effectiveness of the digital platform employed suggests the viability of open educational resources for fostering critical 21st-century skills within diverse cultural and educational contexts. Consequently, educational institutions should invest in scalable digital interventions designed specifically for entrepreneurship education, as they not only enhance complex thinking but also promote economic resilience and community-driven development.

Secondly, considering the variability in initial competency levels and the differential gains observed between countries, educators and curriculum developers should tailor learning materials to align more closely with local educational contexts and learner characteristics. Adopting such localized approaches could enhance learner engagement, thereby maximizing the educational benefits of digital learning platforms.

Finally, the apparent success of digital educational platforms in fostering skills linked to social entrepreneurship underscores their potential as powerful tools to address socioeconomic disparities through education. By equipping students and educators with the competencies needed to navigate complex problems creatively and sustainably, these platforms directly support broader goals related to social innovation, economic empowerment, and sustainable development in Latin America and beyond.

## Conclusions

This study examined the impact of an open digital learning platform in enhancing complex thinking competencies through social entrepreneurship education in higher education contexts. Specifically, it assessed changes in scientific, critical, innovative, and systemic thinking among learners in Mexico and Bolivia. Findings from pre-test and post-test evaluations indicated significant improvements in participants' perceived competencies across both countries, though slight variations emerged regarding areas of greatest improvement.

Overall, the study demonstrates the value of integrating social entrepreneurship education through digital platforms, particularly in contexts facing socioeconomic and developmental challenges, suggesting their effectiveness in cultivating skills vital for sustainable development. The training workshops did enhance learners' ability to approach complex socioeconomic challenges creatively and systematically, reflecting the potential for digital education to promote equitable, accessible, and quality learning experiences.

Future research could explore longitudinal effects to better understand sustained impacts on participants' competencies and incorporate more diverse assessment tools to triangulate self-perceptions with objective measures of skill development. Additionally, ongoing refinements to the educational platform should consider learners' feedback on content delivery and methodology, thereby enhancing the relevance, accessibility, and educational impact of open education resources within higher education and vocational training curricula.

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