SEL4C: Mobile Application for the Development of Social Entrepreneurship Competency

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***Abstract*—Universities must ensure their students acquire competencies that empower them to act as genuine catalysts for transformation. This necessitates, beyond imparting disciplinary skills and knowledge, the integration of cross-disciplinary competencies to equip them to navigate the complexities of their surroundings effectively. This study delineates the outcomes from deploying a mobile application aimed at fostering entrepreneurial intent among students at a technological university in Mexico. The objective was to enhance the perception of attainment in social entrepreneurship skills among students from fields not traditionally linked to business or entrepreneurship. From a methodological standpoint, a multivariate descriptive analysis was conducted using R software and RStudio, incorporating mean analyses, with further insights provided by violin and box plots. The findings reveal that the mobile application significantly contributes to the cultivation of social entrepreneurship skills, establishing itself as a feasible and pertinent technological instrument for nurturing agents of change. Notably, while female students exhibited superior average scores, male students demonstrated more considerable development in these competencies. This research is situated within the domain of Technology Applied to Education and Educational Initiatives via Mobile Applications.**

***Keywords*—professional education, life-long learning, educational innovation, educational technology, mobile applications, social entrepreneurship, complex environments**

I. Introduction

Social entrepreneurship focuses on addressing local challenges with the primary goal of generating a positive impact on the community [1]. Unlike traditional business ventures, social entrepreneurs seek to balance economic profit with social impact, ensuring the sustainability of their projects [2]. A social entrepreneur not only generates resources but also identifies local problems and develops innovative solutions to address them [3]. In this context, social entrepreneurship is presented as an exceptional alternative to altruism and philanthropy, as it addresses social problems while also promoting autonomy and sustainability [4]. In regions such as Latin America, there is a growing interest in the development of social entrepreneurship projects. These efforts consider the specific issues of each location while also recognizing common challenges across the region [5]. Universities in the region are implementing tools to bring social entrepreneurship closer to students from various disciplines, acknowledging that any future professional can benefit from innovative skills to empower their communities and improve their environments [6]. However, not all universities possess the specialized resources necessary to nurture and support their students' entrepreneurial ambitions, which could potentially limit these students' capacity for change.

Building on this perspective, a team of academics from the Tecnológico de Monterrey designed the Social Entrepreneurship Learning for Complexity (SEL4C) methodology. This approach, through a set of educational activities, enables individuals from any background or field of study to acquire and develop skills associated with social entrepreneurship [7]. To extend the reach of this methodology, the SEL4C Mobile Application has been developed as a technological tool that leverages the benefits of a cellphone to trigger entrepreneurial ideation processes related to local problems.

This study seeks to present the results from the implementation process of the SEL4C mobile application among a group of students at a technological university in Mexico. The goal is to determine whether the use of this technological tool improves the perception of achievement of social entrepreneurship competence among students in disciplines not traditionally associated with entrepreneurship or business. Methodologically, the study employed a multivariate descriptive analysis to measure the development of the competency and its sub-competencies before and after utilizing this technological tool.

II. Literature Review

A. The Relevance of Building Competencies for Lifelong Learning

In the current educational landscape, pedagogical approaches oriented towards competency development have gained prominence, responding to the need to prepare students for the complex and ever-changing challenges of the contemporary world [8]. Unlike conventional methods that focus solely on knowledge acquisition, these models prioritize the cultivation of skills and abilities. This emphasis empowers students to navigate diverse situations and apply their learning effectively in real-world contexts [9].

Within these innovative approaches, education shifts towards the active construction of applicable knowledge, with teachers serving as facilitators of learning. They guide students through exploration, investigation, and problem-solving processes [10]. Interaction and active

participation are crucial; students engage in projects, collaborate with peers, and apply their learning in authentic situations, making the educational experience more relevant and impactful [11].

These models are designed to enhance the acquisition of interdisciplinary skills, including critical thinking, efficient communication, collaborative teamwork, creativity, and adept problem-solving abilities. Simultaneously, they focus on cultivating technical and field-specific competencies that directly address the tangible requirements of their respective professions [12]. The aim is to equip students with the ability to not merely grasp theoretical concepts but also to effectively implement these ideas across various scenarios, demonstrating adaptability to novel situations and obstacles [13].

In these competency-based approaches, assessment evolves from traditional multiple-choice tests to embrace more authentic and diverse methods. These include project presentations, complex problem-solving exercises, evidence portfolio construction, and peer assessment [14]. Such methods aim to evaluate not only the student's theoretical knowledge but also their capability to apply this knowledge in practical situations [15].

A significant advantage of these methods lies in their applicability to both professional settings and daily life, as they cultivate competencies that are transferable to a variety of real-world contexts. This prepares future professionals to navigate the complexities of an ever-evolving society [16]. Furthermore, these models promote continuous and lifelong learning, underscoring the importance of adaptability and ongoing skill development [17].

B. The Use of Mobile Applications in the Field of Education

In the contemporary landscape of higher education, the incorporation of mobile applications has catalyzed a significant transformation in teaching methodologies and the cultivation of professional competencies. These digital tools have unlocked access to an extensive array of resources and knowledge, thereby enhancing the development of practical skills that align with the requirements of the modern labor market [18]. Mobile applications have redefined the confines of traditional education, enabling university students to pursue a more autonomous and tailored learning experience, which is indispensable in an era characterized by the necessity for adaptability and ongoing learning. Platforms like Khan Academy and Coursera exemplify how these applications deliver a broad spectrum of knowledge that surpasses the confines of conventional academic curricula [19].

Beyond imparting theoretical knowledge, these applications facilitate experiential, specialized learning. For instance, Duolingo and Py engage users in interactive sessions to master technical skills, whereas Prognosis and Visual Anatomy offer pragmatic experiences in fields such as medicine. Furthermore, essential workplace competencies, including soft and management skills, are bolstered by tools like LinkedIn Learning and Evernote, which aid in organizing tasks and honing leadership and communication abilities [20]. The adoption of these digital tools signifies a shift towards more dynamic and adaptable educational practices.

In the realm of entrepreneurship, platforms such as LinkedIn Learning, Coursera, TED Talks, Mind Tools, and Asana are instrumental in nurturing entrepreneurial and leadership competencies. These applications provide a vast range of learning opportunities, from business management courses to leadership strategies imparted by distinguished professionals and scholars. TED Talks serve as a source of inspiration and insight through speeches by global figures, while Evernote and Habitica enhance organizational skills and encourage productive habits. Asana, a project management application, streamlines team coordination and collaboration [21]. The integration and proficient utilization of these applications within the university setting arm students with the critical skills required to navigate and flourish in a dynamic and ever-evolving professional landscape [22].

C. Social Entrepreneurship Competency

Social entrepreneurship stands out for its commitment to tackling social issues within communities through solutions that are sustainable over the long term [23]. Unlike traditional entrepreneurs, social entrepreneurs are distinguished by their social mission or purpose, with a primary focus on addressing the challenges present in their immediate environment through innovative activities [24]. Typically, social entrepreneurs devise innovative solutions to social problems, culminating in the creation of products, services, business models, or approaches that address specific challenges effectively and sustainably.

As identified by the international organization Ashoka [2], social entrepreneurs are heralded as genuine agents of change, reshaping their environments with impactful ideas aimed squarely at mitigating social inequalities. Although social entrepreneurship has a broad reach, its focal areas may differ by region, targeting specific social challenges with the understanding that local issues are most effectively addressed locally [25].

The significance of social entrepreneurship in regions such as Latin America is underscored by its unique set of social and economic challenges, which are often the focus of social impact projects [26]. Importantly, the entrepreneurial aspect of these projects has the potential to create jobs and stimulate economic development, thereby contributing to the sustainable advancement of the region [27]. Shapovalov *et al*. [28] highlight the social dimension and the skills needed to identify and seize opportunities—qualities that are also found among traditional entrepreneurs. Social entrepreneurship competencies provide a comprehensive education, offering vital knowledge on the management of entrepreneurial projects and skills for identifying and addressing community issues.

García-Gonzalez *et al*. [29] present a framework for social entrepreneurship that includes four sub-competencies and 17 related indicators, covering personal, leadership, innovation, social value, and entrepreneurial management skills. This framework diverges from more traditional models, such as those proposed by Sáenz-Bilbao and López-Vélez [27] and Portuguez, Valenzuela, & Navarro [30], by not only detailing

specific aspects of social entrepreneurship but also incorporating personality traits, in line with Ashoka's [2] perception of change agents.

García-Gonzalez *et al*. [29] suggest that every social entrepreneur requires the following subcompetencies and cognitive elements:

- Self-control: Including motivation, perseverance and resilience, tolerance to uncertainty, ambiguity, and stress mastery.
- Leadership: Considering strategic planning, communication and persuasion, mobilization of people, and collaborative work.
- Social awareness and value: Including social involvement, empathy, identification of social/environmental issues, sustainability orientation, and ethical sense.
- Social innovation and financial sustainability: Encompassing creativity, economic and financial literacy, valuing ideas, results, and impacts on the environment and people, learning and adaptability, and management of limited resources for social projects.

Social entrepreneurship training endows individuals with the crucial skills needed to initiate entrepreneurial ventures, alongside imparting the knowledge and competencies required to tackle local social issues. This training empowers individuals, ignites their innovative spirit, and propels economic development, thus facilitating the cultivation of invaluable entrepreneurial skills [31]. Nonetheless, education in social entrepreneurship requires a more extensive focus on cognitive aspects compared to traditional entrepreneurship, posing a challenge for mentors, educators, and educational institutions that might not possess the specialized resources necessary for teaching these competencies [7].

D. Social Entrepreneurship Learning 4 Complexity (SEL4C)

Training in social entrepreneurship does not require a specialization in entrepreneurship itself but rather necessitates tools that provide guidance to students through their innovation processes. This is precisely the role of the SEL4C mobile application.

An interdisciplinary research group developed a methodology aimed at acquiring and enhancing social entrepreneurship competence. This methodology comprises nine practical activities designed to ideate and construct a foundational social entrepreneurship project. Crafted by a team of specialists in social entrepreneurship with expertise in pedagogy and instructional design, the methodology, upon several implementations, was validated as effective, showing a 6.2% increase in the perception of achievement in social entrepreneurship competency during the entrepreneurial ideation process [7].

In an effort to broaden the methodology's reach to a wider audience and more educational institutions, a condensed version was developed. This streamlined version, while shorter, retained the original's effectiveness and validity. It outlines four stages—Identification, Research, Ideation, and Socialization—across five activities, aiming to foster entrepreneurial spirit and competence.

To achieve a greater impact, the development of a technological tool embodying this methodology led to the creation of the SEL4C Mobile Application. Designed specifically for iOS devices, the app facilitates the development of users' understanding of social entrepreneurship competence through entrepreneurial ideation. It comprises five practical activities that guide students through identifying environmental issues, researching their status on international, national, and local scales, considering solutions from other contexts, initiating an ideation process for innovative proposals, and crafting a pitch to effectively communicate their proposal.

The methodology includes two evaluations of perceived achievement in social entrepreneurship competence—one at the beginning and another at the end—to accurately measure the development of users' skills and entrepreneurial mindset.

Hence, this research and the SEL4C application aim to address the challenge of educational accessibility in entrepreneurship training, aligning with Sustainable Development Goal 4: Quality Education. Despite numerous institutions' efforts to foster entrepreneurship, the lack of specialized financial and human resources often leads to the loss of potentially impactful ideas. The SEL4C app is introduced as a universally accessible tool for anyone aspiring to become an entrepreneur, addressing this gap.

III. Materials and Methods

A. Population and Implementation

During September and October 2023, a pilot test of the SEL4C mobile application was carried out among a cohort of 118 students at a technological university in Mexico. In keeping with the guiding principles of the methodology, particular attention was paid to ensure the inclusivity of the participant group; specifically, students were selected such that none were business majors nor had they received prior entrepreneurship training. Moreover, an effort to maintain gender balance resulted in a group consisting of 65 women and 53 men. The process mandated each participant to download the application onto their cellphones and sign up to partake in the designated activities spanning a five-week period. Consent was obtained from all participants for the use of their responses, results, and data for academic research purposes, adhering to the methodology's privacy notice [32].

The implementation process through the application considers 5 moments:

1) Registration: At this stage, participants provide socio-demographic data to enable potential analysis of usage patterns and insights into their developmental processes. They also agree to the privacy notice and the terms and conditions of the platform.
2) Initial Diagnosis: Upon completing registration, each participant is required to fill out the "Profile of the Social Entrepreneur" instrument. This step is crucial for gauging their initial perception of achievement in social entrepreneurship.
3) Training Activities: Participants engage in the five activities designed according to the condensed version of the methodology. These activities are structured to systematically develop their understanding and skills in social entrepreneurship.
4) Closing Evaluation: After finishing the training activities,

participants complete the "Social Entrepreneur Profile" instrument again. This post-intervention assessment measures any changes in their competence perception, offering insights into the impact of the educational activities.

5) Follow-up Suggestions: Recognizing the methodology's focus on entrepreneurial ideation, users are provided with information about potential regional entrepreneurship environments. These recommendations aim to guide participants on where they might compete or submit their proposals for support or potential funding, fostering further development and engagement in the entrepreneurial ecosystem.

B. SEL4C App

The SEL4C application is crafted specifically for Apple's iOS operating system, embedding technical specifications that ensure seamless functionality and compatibility with Apple's array of devices. It features a User Interface (UI) designed to enhance user experience through its simplicity and intuitiveness. The application boasts legible typography and a responsive design, accommodating various screen sizes, orientations, and models of iPhones and iPads. The development utilized Apple's suite of development tools and the Swift 5 programming language, establishing a connection to the web server via the JSON-REST protocol. Quality assurance was conducted through comprehensive testing across different devices and versions of iOS.

In parallel, a web portal was developed, comprising three distinct layers. The front-end layer employs JavaScript, CSS, and HTML technologies to create a dynamic and visually appealing graphical interface. The server tier is powered by Django-Python, ensuring robust back-end functionality. The database tier is structured on a relational schema, facilitating efficient data management and retrieval.

C. Instrument

The assessment of social entrepreneurship competency is conducted using the Social Entrepreneur Profile instrument, a questionnaire developed and validated by García-González *et al*. [33]. This tool has been specifically tailored for use in educational settings that may not exclusively focus on entrepreneurship [34]. Designed for self-administration, its primary aim is to evaluate the level of perceived achievement in social entrepreneurship competencies.

The significance of gauging perceived achievement lies in the critical role of self-perception in skill development. Without perceiving oneself as competent, an individual might face limitations in applying their knowledge effectively when making decisions or confronting personal or professional challenges. Although measuring perception may introduce bias, the instrument has demonstrated its utility across various contexts by yielding insightful outcomes.

The questionnaire (Table 1) is structured around 24 items, reflecting four pivotal subcompetencies within the social entrepreneurship profile: (a) self-control (items 1-4), (b) leadership (items 5-10), (c) social awareness and value (items 11-17), and (d) social innovation and financial sustainability (items 18-24). Responses are collected using a Likert scale, where 5 = strongly agree and 1 = strongly disagree, allowing for nuanced insights into participants' perceptions of their competencies.

Table 1. Entrepreneurial profile instrument items

	Item
1	When I am passionate about something I do my best to achieve my goals.
2	When I am passionate about my work, I do my best to finish it, even if I face adverse circumstances, lack of time or distractions.
3	Despite rejection or problems, I always seek to achieve my goals.
4	I am tolerant of ambiguous situations or situations that generate uncertainty.
5	I have the ability to establish a clear goal and the steps to achieve it.
6	I often manage to convince others about my ideas and actions.
7	I master different ways of communicating my ideas: in writing, in a video or in face-to-face talks.
8	I am able to delegate activities to my team members according to their profiles.
9	I have the ability to identify the strengths and weaknesses of the people I work with.
10	I am facilitated to collaborate actively in a team to achieve common goals.
11	I am passionate about working for social causes.
12	I believe that my life's mission is to work for social change and improve people's lives.
13	I am interested in leading an initiative with favorable results for society and/or the environment.
14	I am able to identify problems in the social or environmental environment to generate innovative solutions.
15	I am committed to participate in social aspects of my environment.
16	I believe that economic growth should occur with equal opportunities and equity for all.
17	My actions and behaviors are governed by moral standards based on respect and care for people and nature.
18	I know how to apply strategies to create new ideas or projects.
19	I know how to apply accounting and financial knowledge for the development of an enterprise.
20	I have notions about logistics to carry out the management of an organization.
21	I know how to make a budget to achieve a project.
22	I know how to establish evaluation criteria and measure the results of social impact.
23	I believe that making mistakes offers us new learning opportunities.
24	I know strategies to develop a project, even with scarce resources.

Statistical analysis was conducted through a multivariate descriptive approach using R and RStudio software [35]. This analysis entailed calculating mean values and standard deviations to depict the data set's distribution and variability accurately. The mean value, indicating the distribution's central tendency, served to identify the data's equilibrium point.

Conversely, the standard deviation quantified the spread or dispersion of data points around this mean. To complement these numerical insights, violin and box plots were employed as graphical representations, offering a visual summary of the data distribution's density and spread. These plots are particularly useful for understanding the data's overall behavior, highlighting potential outliers, and identifying the distribution's skewness.

IV. Result and Discussion

The implementation of the SEL4C mobile application demonstrated favorable outcomes, with an overall 5.9% enhancement in participants' perceived achievement of social entrepreneurship competency. More detailed analysis revealed substantial improvements across various

sub-competencies: social innovation and financial sustainability saw a notable increase of 10%, leadership improved by 5.8%, and social awareness and value by 5.6%. While the self-control sub-competency exhibited a modest gain of 1.3%, these results collectively affirm the methodology's positive impact on fostering social entrepreneurship skills (Table 2).

Table 2. Results of the level of perceived achievement of the social entrepreneurship competency and its subcompetencies

Variable	Application		Standard deviation	
	Initial	Final	Initial	Final
Social Entrepreneurship	4.20	4.45	0.91	0.73
Self-control	4.54	4.6	0.66	0.70
Social Awareness and Value	4.26	4.50	0.88	0.71
Social Innovation and. Financial Sustainability	3.87	4.26	1.09	0.74
Leadership	4.27	4.52	0.76	0.70

The outcomes are more vividly illustrated in Fig. 1, where a violin plot not only highlights the development of perception in terms of its mean but also showcases the concentration of positive perception outcomes. Following the application of the methodology, a significant number of students reported perceiving themselves as more competent overall, indicating a shift in self-assessment towards a more positive evaluation of their social entrepreneurship skills.

This graphical representation provides a comprehensive view of the changes in perception, illustrating both the average improvement and the distribution of responses, thereby underscoring the effectiveness of the educational intervention.

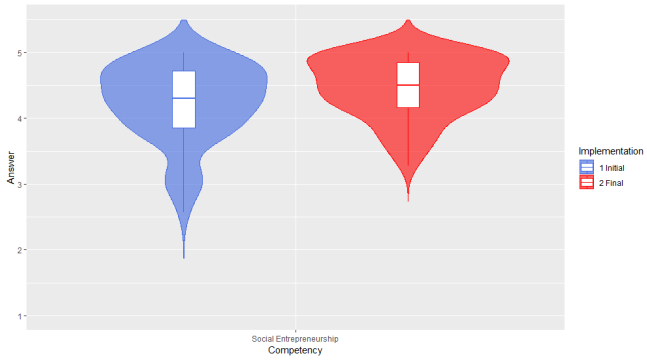

Fig. 1. Results of the social entrepreneurship competency (initial diagnosis-final diagnosis).

To further elucidate the findings, Fig. 2 features a series of boxplot analyses depicting both the initial and final results concerning the subcompetencies linked to the social entrepreneur profile. This figure demonstrates discernible progress within each subcompetency following the implementation.

The visual comparison between initial and final outcomes offers a clear indication of development, showcasing not only the median improvements but also changes in the interquartile ranges and potential outliers. This detailed analysis provides a nuanced understanding of how the educational intervention fostered growth across the different areas of social entrepreneurship competence.

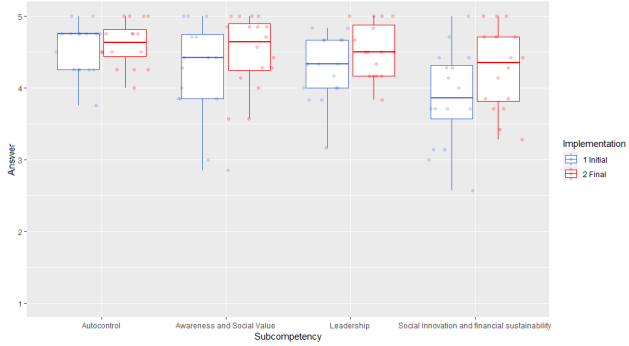

Fig. 2. Results by sub-competency of the social entrepreneurship competency (initial diagnosis-final diagnosis).

To offer more detailed insights into the implementation process, the results were further segmented by gender. Table 3 displays the means and standard deviations for both the initial and final assessments among male and female participants. This division allows for a nuanced analysis of how the methodology impacted each gender, highlighting potential differences in perception improvement. By comparing the initial and final metrics for men and women, it's possible to discern the extent to which the educational intervention influenced their perceived competencies in social entrepreneurship, providing valuable data on gender-specific responses to the training.

Table 3. Initial and final results divided by gender

Variable	Gender	Application		Standard deviation	
		Initial	Final	Initial	Final
Social Entrepreneurship	Men	4.06	4.41	0.91	0.71
	Women	4.30	4.51	0.91	0.73
Self-control	Men	4.47	4.47	0.64	0.65
	Women	4.64	4.78	0.66	0.70
Social Awareness and Social Value	Men	3.87	4.57	0.88	0.67
	Women	4.77	4.73	0.88	0.71
Social Innovation and. Financial Sustainability	Men	3.84	4.34	1.09	0.71
	Women	3.91	4.16	1.09	0.74
Leadership	Men	4.25	4.53	0.76	0.70
	Women	4.28	4.50	0.76	0.70

Table 3 shows that women generally begin with higher averages in both overall competencies and subcompetencies. However, after implementation, this trend does not uniformly persist. In the subcompetencies of Social Awareness and Value, Social Innovation and Financial Sustainability, and Leadership, despite women initially holding better perceptions, they are overtaken by men in terms of improvement.

It's crucial to differentiate between the average level of perceived achievement and the actual progress made through the application's use. While women attain a higher average competence score (4.51), men display more significant development, with an increase of +8.6%. This pattern recurs across most subcompetencies, with men showing more substantial progress than women.

Men witnessed an 8.6% enhancement in their perceived competence, along with notable advancements in subcompetencies. The most considerable growth was in Social Awareness and Social Value at 18%, followed by Social Innovation and Financial Sustainability at 13%, and Leadership at 6.5%. The Self-control subcompetency in men remained unchanged.

For women, the perceived achievement in social entrepreneurship competency increased by 4.8%. In subcompetencies, the largest improvement was in Social Innovation and Financial Sustainability at 6.3%, then Leadership at 5.1%, and Self-control at 3%. Conversely, Social Awareness and Social Value not only did not improve but decreased by nearly 1%. One participant noted the methodology made her more aware of her limited knowledge about local problems, leading to a more critical self-assessment. This numerical decrease might reflect the instrument's nature for gauging self-perception. These findings suggest that men benefited more from this technological tool, highlighting the need for further research to understand these gender differences.

V. Conclusion

The SEL4C mobile application has proven to be an effective technological tool for improving perceptions of social entrepreneurship competency and its subcompetencies, demonstrated by a 5.9% enhancement in participant perceptions and a more uniform response pattern. Remarkably, men exhibited greater progress, consistent with the application's foundation on a validated methodology, thereby confirming its efficacy in replicating prior testing outcomes. The application's effectiveness in this study highlights its potential utility in educational contexts that are deficient in specialized resources for fostering entrepreneurial skills.

Nonetheless, these findings are preliminary, marking the principal limitation of this study as it necessitates further investigations for a more objective validation. Future research should encompass students from diverse institutions and undertake comparisons between the SEL4C app and other technological tools with similar aims. Such investigations would yield a broader perspective on the app's capacity to cultivate social entrepreneurship competencies.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualization, J.C.V.-P., and M.B.-F.; methodology, P.S-B.; software, P.S-B.; validation, J.C.V.-P; formal analysis, J.C.V.-P., and M.B-F.; investigation, J.C.V.-P., and P.S-B.; resources, J.C.V.-P.; data curation, P.S-B.; writing—original draft preparation, J.C.V.-P.; writing—review and editing, J.C.V.-P., and M.B-F.; visualization, P.S-B.; supervision, J.C.V.-P.; project administration, J.C.V.-P.; funding acquisition, J.C.V.-P.

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