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ORIGINAL

Model for Promoting University Entrepreneurship: "Application and Continuous Improvement at the University of Guadalajara"

Modelo de Ejes para Fomentar el Emprendimiento Universitario "Aplicación y Mejora Continua en la Universidad de Guadalajara"

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ABSTRACT

This study examines the implementation and evolution of the axis model for promoting entrepreneurship at the University of Guadalajara, emphasizing its iterative application and continuous improvement. Using a sequential explanatory mixed research design, the impact of the model on business creation, the development of entrepreneurial skills, and the contribution to the regional innovation ecosystem is evaluated. The results, based on a five-year longitudinal analysis (2018-2023), reveal a significant increase in key performance indicators, including a 320 % increase in startup creation and a 280 % increase in registered patents. Subsequent qualitative analysis identifies critical success factors, such as the multidimensional integration of the entrepreneurial ecosystem and the agile adaptation of the model. This study contributes to the literature on entrepreneurial universities in emerging contexts and offers practical implications for higher education institutions in Latin America.

Keywords: University Entrepreneurship; Axis Model; Continuous Improvement; University of Guadalajara; Entrepreneurial Ecosystem.

RESUMEN

Este estudio examina la implementación y evolución del modelo de ejes para el fomento del emprendimiento en la Universidad de Guadalajara, con énfasis en su aplicación iterativa y mejora continua, utilizando un diseño de investigación mixto secuencial explicativo, se evalúa el impacto del modelo en la creación de empresas, el desarrollo de competencias emprendedoras y la contribución al ecosistema de innovación regional, los resultados, basados en un análisis longitudinal de cinco años (2018-2023), revelan un incremento significativo en indicadores clave de desempeño, incluyendo un aumento del 320 % en la creación de startups y un 280 % en patentes registradas, el análisis cualitativo subsecuente identifica factores críticos de éxito, como la integración multidimensional del ecosistema emprendedor y la adaptación ágil del modelo, este estudio contribuye a la literatura sobre universidades emprendedoras en contextos emergentes y ofrece implicaciones prácticas para instituciones de educación superior en América Latina.

Palabras clave: Emprendimiento Universitario; Modelo de Ejes; Mejora Continua; Universidad de Guadalajara; Ecosistema Emprendedor

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INTRODUCTION

Problem

In he context of the knowledge economy, higher education institutions have expanded their role beyond teaching and research, consolidating themselves as drivers of economic and social development. This phenomenon, known as the "third mission" of universities, seeks to strengthen the relationships among academia, industry, and government through knowledge transfer, the creation of technology-based companies, and the training of entrepreneurial talent.[1]

However, in emerging countries such as Mexico, models for promoting university entrepreneurship face multiple challenges. The University of Guadalajara, as one of the leading HEIs in Latin America, has implemented the Model of Axes for Promotion of Entrepreneurship, an innovative approach that seeks to improve the entrepreneurial ecosystem through iterative application and continuous improvement. Nevertheless, questions remain about its real impact on the creation of startups, the training of entrepreneurs, and coordination with the productive sector.

The lack of convergence between universities, industry, and government

The Triple Helix model, which proposes interactions between universities, companies, and government entities as the basis for innovation, continues to be a challenge in the Mexican context.[2] Despite initiatives to strengthen this synergy, universities still face difficulties in linking with the productive sector because of a lack of incentives, flexible regulatory frameworks, and effective channels for technology transfer.

The entrepreneurial ecosystem in Mexico does not always facilitate effective connections between academia and the business world, which limits the development of university startups and spin-offs. At the University of Guadalajara, this disconnect translates into poor use of the knowledge generated in research and reduced participation by external actors in entrepreneurship programs.

Limitations in the development of entrepreneurial skills

Despite efforts to integrate entrepreneurship into curricula, the development of entrepreneurial skills among students remains uneven. The lack of effective teaching methodologies to foster skills such as risk-taking, resilience, and entrepreneurial creativity hinders the transformation of knowledge into sustainable business initiatives.[3]

Several studies indicate that attitude is a determining factor in entrepreneurial intent, but the perception of risk and lack of confidence in the viability of one's own business remain persistent barriers among students. In this context, the University of Guadalajara faces the challenge of strengthening training programs that not only provide technical tools but also foster an entrepreneurial mindset.

Fragmented entrepreneurial ecosystems and lack of support infrastructure

The success of university entrepreneurship depends on the existence of a robust ecosystem that provides financing, mentoring, and access to collaborative networks. However, in Mexico, access to seed capital and acceleration programs is limited for university entrepreneurs, which reduces the survival rate of new companies.

At the University of Guadalajara, although incubation spaces and mentoring programs have been established, these do not always manage to integrate with the productive and investment sectors, which hinders the scalability of startups.[4] It is crucial to strengthen the mechanisms for linking with investors and established companies to facilitate the growth of ventures born at the university.

Toward a model of continuous improvement in the promotion of university entrepreneurship

Given the importance of entrepreneurship as an engine of economic and social development, the University of Guadalajara has committed to a model of continuous improvement that seeks to optimize its strategies for promoting entrepreneurship. To this end, considering the following aspects is essential:

1. Review and Adjustment of Teaching Strategies: Incorporate active learning methodologies, such as a project-based approach, business simulations, and real-life entrepreneurial experiences.
2. Strengthening Links with Industry: Creating collaboration programs with companies that allow students and graduates to access financing, mentoring, and scaling opportunities.
3. Development of Institutional Policies to Support Entrepreneurship: Establishing clear incentives for professors and researchers who participate in innovation and technology transfer projects.
4. Promoting Open Innovation Models: Encourage interdisciplinary collaboration and the cocreation of solutions with external actors.

Universities have the potential to become key players in the transformation of the socioeconomic environment, but this requires more effective integration among academia, industry, and government. Only through a holistic vision and a solid institutional commitment t ism will it be possible to consolidate a model of university entrepreneurship that generates a significant impact on society.[5]

Theoretical foundation

Higher education has evolved significantly in recent decades, becoming a key agent for the generation of knowledge, innovation, and economic development.[6] Universities not only play a formative role in the academic sphere but also become an ecosystem where new ideas are incubated and entrepreneurial initiatives with an impact on society are generated.

This phenomenon falls within the concept of the entrepreneurial university, a model that integrates teaching, research, and links with the productive environment to promote the creation of companies and the strengthening of human capital with an innovative orientation. In this sense, the University of Guadalajara has implemented the Model of Axes to promote university entrepreneurship, a strategy based on principles of continuous improvement and adaptation to the socioeconomic context of the region.[7]

From traditional universities to entrepreneurial universities

The concept of the entrepreneurial university was consolidated in the studies of Clark 1998, who highlighted the need to transform educational institutions into spaces for innovation and entrepreneurship. González et al.[2] subsequently integrated it into the Triple Helix framework, highlighting the interaction between universities, industry, and government as a key model for the generation of applied knowledge.

In Latin America, the development of university entrepreneurship has followed a process of adaptation to local conditions, with studies highlighting the importance of considering structural and cultural factors in its implementation. In this context, the University of Guadalajara has made progress in consolidating strategies aimed at strengthening the entrepreneurial training of its students.[8]

Models for promoting university entrepreneurship

Various models have been proposed to promote entrepreneurship in the university environment. Cuartas et al.[8] suggest an approach based on experimentation and practical learning, using methodologies such as the following:

- Business simulations
- Problem-based learning
- Links with businesses and communities.

On the other hand, Neri[9] emphasize the development of entrepreneurial skills through the following:

- The creation of support networks
- Formation of interdisciplinary teams
- Generation of financing opportunities.

The University of Guadalajara's Core Model incorporates elements of these approaches but adapts them to its institutional context, prioritizing connection with the productive environment and the development of entrepreneurial skills throughout the students' educational trajectory.

Triple Helix as a framework for university–industry–government relations

The Triple Helix model, mentioned by González[10], proposes that innovation arises from the dynamic interaction between the following:

1. Universities as generators of knowledge and talent.
2. Companies that transform knowledge into products and services.
3. Governments, which establish policies to promote innovation.

In Mexico, the implementation of this model has encountered challenges, especially in terms of effective links between these sectors. The University of Guadalajara has worked to strengthen these relationships, although challenges remain in articulating incentives for technology transfer and financing entrepreneurial initiatives.

Entrepreneurship ecosystems in higher education

The concept of an entrepreneurial ecosystem has been developed as a comprehensive framework for analyzing the conditions that favor entrepreneurial activity. A solid ecosystem must include the following:

- Support infrastructure, such as incubators and accelerators.
- Access to financing through investment funds and seed capital.
- Collaborative networks that connect entrepreneurs with mentors and experts.

Universities play a crucial role in consolidating these ecosystems, acting as facilitators of access to resources and *networking* opportunities. Although the University of Guadalajara has developed initiatives to strengthen entrepreneurship, the following limitations have been identified:

- The integration of entrepreneurial education across all disciplines.
- Effective links with the productive sector.
- Access to financing and mentoring for emerging projects.

Overcoming these challenges requires a strategic approach that prioritizes the coordination of key actors and the development of institutional policies that encourage entrepreneurial culture.

Continuous improvement in entrepreneurship programs

Continuous improvement is a fundamental principle in the management of entrepreneurship programs. The PDCA (plan-do-

check-act) cycle provides a framework for optimizing entrepreneurial training processes:

1. Planning: define strategies and objectives aligned with the needs of the entrepreneurial ecosystem.
2. Execution: implement training and support programs for entrepreneurs.
3. Evaluation: measure the impact of initiatives and collect feedback.
4. Adjustment: introduce improvements on the basis of the results obtained.

This approach ensures that entrepreneurship programs remain up-to-date and aligned with market trends and student needs.

Research objectives

The purpose of this study is to analyze the impact of the Model of Axes for Promotion of University Entrepreneurship at the University of Guadalajara, considering its application, evolution, and continuous improvement within the entrepreneurial ecosystem of higher education. In a context where the university not only performs educational functions but also acts as an agent of development and innovation, this research seeks to generate a frame of reference that allows for the strengthening of strategies and the optimization of entrepreneurial training processes.

To this end, specific objectives are established to guide the analysis and generation of proposals for improvement, considering determining factors such as the interaction between the university, industry, and government; entrepreneurial ecosystems in higher education; and the effectiveness of university entrepreneur training models.

General objective

To evaluate the effectiveness of the Model for Promotion University Entrepreneurship at the University of Guadalajara, considering its impact on the training of entrepreneurs, the consolidation of the university entrepreneurship ecosystem, and its contribution to links with the productive sector.

This objective seeks to determine the extent to which the implementation of the model has contributed to the development of entrepreneurial skills among students,[11] the strengthening of the entrepreneurial culture in the institution, and the consolidation of a support network that facilitates the creation and sustainability of new business initiatives.

Specific objectives

Analysis of the impact of the model on the training of university entrepreneurs

- Examine the development of entrepreneurial skills among students who have participated in the model, considering skills such as creativity, leadership, risk management, and problem solving.
- The pedagogical strategies used in entrepreneurial training within the university should be identified, and their effectiveness in generating entrepreneurial attitudes and skills should be evaluated.
- Determine the factors that influence students' entrepreneurial intentions and the degree of institutional support in their business development process.

Evaluation of the entrepreneurial ecosystem at the University of Guadalajara

- The structure and function of the university entrepreneurship ecosystem should be analyzed, and key actors and available resources to support the creation of new businesses should be identified.
- The entrepreneurial ecosystem at the University of Guadalajara is compared with models implemented at other national and international universities, identifying areas of opportunity and best practices.
- Measure the university community's participation in entrepreneurial activities and their perception of the level of institutional support and access to resources for developing their projects.

Linking with the productive sector and applying the triple helix model

- The relationships among the university, industry, and government in promoting entrepreneurship should be evaluated, and collaboration mechanisms and their impact on the success of the projects undertaken should be identified.
- Examine the participation of companies and government agencies in the training of entrepreneurs, whether through mentoring, financing, or incubation programs.
- We propose strategies to strengthen the integration of the university with the productive sector, promoting knowledge transfer and the creation of university startups with high scalability potential.

Proposal for continuous improvement in the University Entrepreneurship Model

- An evaluation and continuous improvement framework is designed to optimize the model of axes for promoting university entrepreneurship, adapting it to the emerging needs of the entrepreneurial ecosystem.
- The performance indicators that allow for measuring the evolution of the model and its impact on the generation of sustainable, high value-added ventures should be identified.
- Recommendations for the incorporation of innovative methodologies in the teaching of entrepreneurship should be formulated, practical experience should be strengthened, and links with strategic actors in the ecosystem should be established.

The development of university entrepreneurship is a complex process that requires a comprehensive support structure, where the

university acts as a catalyst for innovation and the training of new entrepreneurs. This research seeks to provide a comprehensive analysis of the Model of Axes for Promotion of University Entrepreneurship, identifying its strengths, areas for improvement, and opportunities for its consolidation at the institutional and regional levels.[12]

Through these objectives, the aim is to contribute to the design of strategies that will consolidate an entrepreneurial university capable of generating economic and social value through the training of leaders with an innovative vision and the ability to transform their environment.[13]

METHOD

Research design

This study is based on a sequential explanatory mixed-methods design, which allows for an initial analysis of the quantitative patterns of university entrepreneurship and then delves deeper into its causes and dynamics through a qualitative approach. This methodological approach is ideal for understanding both the impact of the Model of Axes for Promotion of University Entrepreneurship at the University of Guadalajara and the factors that influence students' entrepreneurial intentions.[8]

The study was structured in three interdependent phases:

1. Quantitative phase: longitudinal analysis of entrepreneurship indicators at the University of Guadalajara between 2018 and 2023, using statistical and inferential data.
2. Qualitative phase: in-depth exploration through interviews and focus groups to interpret the quantitative findings.
3. Integration of Results: triangulation of data to validate the findings and formulate recommendations for improving the model.

This approach provides a holistic analysis, ensuring the validity of the results by combining different sources of information and methods of analysis.

Data collection tools and procedure

Quantitative phase

To obtain a broad overview of the evolution of university entrepreneurship at the University of Guadalajara, various sources of structured data were used:

- Institutional records.
- Intellectual property databases.
- Annual survey of students and graduates.

The quantitative analysis included the following:

- Descriptive and inferential statistics to identify trends and correlations between variables.
- Time series analysis to evaluate the evolution of entrepreneurship indicators.
- Structural equation modeling (SEM) is used to examine the causal relationships between the factors influencing entrepreneurial intent and the success of university startups.

Qualitative phase

To gain an in-depth understanding of the qualitative factors that affect entrepreneurship at the University of Guadalajara, various research techniques were implemented:

- In-depth interviews were conducted with 25 key actors, including students, teachers, graduate entrepreneurs, and entrepreneurship program managers.
- Focus groups consisting of four groups of eight participants each (total n=32), with the aim of analyzing perceptions of the effectiveness of the entrepreneurship model and opportunities for improvement.
- Documentary analysis of institutional policies, strategic plans, and best practice documents on university entrepreneurship.

The qualitative analysis was carried out using a study thematic analysis approach, which allowed us to identify recurring patterns in the perceptions of the actors involved in the entrepreneurial ecosystem at the University of Guadalajara.

Validation of Results

To improve the accuracy of the analysis and interpretation of the data, the following strategies were used:

- Member Checking: Preliminary findings were shared with the interview and focus group participants to validate the interpretation of their testimonies.
- External Audit: Evaluation of the research process by experts in university entrepreneurship analysis methodologies to ensure the reliability and transparency of the study.

RESULTS

This study analyzes the implementation and evolution of the Model of Axes to Promote University Entrepreneurship at the

University of Guadalajara, evaluating its impact on the training of entrepreneurs, the strengthening of the university ecosystem, and the link with the productive sector. Through quantitative and qualitative analysis, key trends, success factors, and areas of opportunity were identified that allow for an understanding of the scope and effectiveness of the model in promoting university entrepreneurship.

The results reflect a significant increase in the main performance indicators related to business creation, intellectual property, and student participation in entrepreneurship programs. Similarly, persistent challenges were detected that limit the scalability of the model and its financial sustainability, which raises the need for strategic adjustments to ensure its continuity and expansion.[10]

Impact of the axis model

The analysis of data collected between 2018 and 2023 made it possible to evaluate the impact of the model on various aspects of university entrepreneurship. Through a longitudinal evaluation, growth trends in key indicators were identified, reflecting the consolidation of the entrepreneurial ecosystem within the University of Guadalajara.

Evolution of key indicators

The following table shows the evolution of the model's main performance indicators over a five-year period:

Table 1. Variation in indicators

Indicator	2018	2023	Change (%)
Startups created	45	189	+320
Patents registered	15	57	+280
Funding obtained (MXN)	1.2 M	8.5 M	+608
Students in entrepreneurship programs	1,200	5,800	+383
Agreements with companies	25	120	+380

Analysis of these data indicates that the model has led to significant growth in the number of university startups, patent registrations, and funding for entrepreneurial projects. Similarly, the increase in student participation and agreements with companies reflects a strengthening of ties with the productive sector.

Critical success factors

In addition to the quantitative analysis, interviews and focus groups were conducted to identify the qualitative elements that contributed to the model's effectiveness. On the basis of a thematic analysis, five key factors were identified:

The model's six-axis structure has made it possible to address entrepreneurship in a comprehensive manner, incorporating training, incubation, and links with the business ecosystem. The participants highlighted that this structure has facilitated the transition of business ideas from the conceptual phase to business consolidation. Similarly, collaboration with companies has been fundamental to the model's success. The participation of the private sector in mentoring, financing, and startup acceleration programs has strengthened the connection between academia and the market, reducing the gap between education and business practices.[9]

The willingness to try new methodologies and adjust strategies has allowed for the constant evolution of the model. Feedback from students and teachers has facilitated iterative improvements, consolidating an approach based on innovation and flexibility. Similarly, the support of university authorities has been decisive in the implementation and expansion of the model. The allocation of resources and the prioritization of entrepreneurship in the institutional agenda have allowed for its consolidation as a central strategy in university education.

Challenges and limitations

Despite the success of the model, several challenges were identified that require attention to ensure its sustainability and expansion:

- Financial sustainability: dependence on external funding poses a risk to the model's continuity. A strategy is needed to diversify funding sources and generate self-managed income.
- Scalability of the model: currently, the model operates in certain university centers, but its expansion to the entire University of Guadalajara presents logistical and administrative challenges.
- Measuring long-term impact: more accurate metrics need to be developed to assess the real impact of the model on graduates' career paths.
- Balance between entrepreneurship and academia: it must be ensured that entrepreneurial training does not interfere with students' academic training.

The Model for Promoting University Entrepreneurship has had a positive effect on the University of Guadalajara, boosting the creation of companies, strengthening links with the productive sector, and consolidating a robust entrepreneurial ecosystem. However, to ensure its long-term success, it is essential to address the challenges identified and continue to improve the model. These findings provide a solid basis for future strategies to promote entrepreneurship in the university environment.

DISCUSSION

When the findings of this study are compared with those in the literature on university entrepreneurship, several distinctive elements are identified that position the axis model as a benchmark in the region:[12]

Contextual Adaptation as the Key to Success

The success of the model lies in its ability to adapt global conceptual frameworks to local reality, allowing it to align with the characteristics of the entrepreneurial ecosystem in Mexico, unlike standard approaches that replicate foreign models without considering context. The structure of the University of Guadalajara model has been designed on the basis of the specific needs of its university community.

Continuous Improvement as a Differentiating Factor

One of the least explored elements in the literature on university entrepreneurship in Latin America is the systematic application of continuous improvement cycles. In this context, the University of Guadalajara model represents an innovation by implementing iterative strategies that guarantee its constant evolution and alignment with the demands of the environment.

Challenges in Financial Sustainability and Scalability

Despite its many benefits, the model faces significant challenges in terms of financial sustainability and scalability. Dependence on external resources and the need for greater institutionalization of the model are factors that must be addressed to ensure its long-term consolidation.

CONCLUSIONS

This study has made it possible to evaluate the impact of the Model for Promotion of University Entrepreneurship at the University of Guadalajara, analyzing its effectiveness in training entrepreneurs, its impact on the university ecosystem, and its contribution to economic and social development through a comprehensive methodological approach.

The main successes of the model were identified, as well as areas of opportunity that require attention to ensure its sustainability and scalability.

This section presents the general conclusions of the study, discussing the most relevant findings in relation to the literature and university entrepreneurship models implemented in other contexts. In addition, recommendations are made for improving the model, emphasizing the importance of continuous improvement and integration with strategic actors in the entrepreneurial ecosystem.

Key contributions of the axis model

The results obtained throughout the research demonstrate that the axis model is an effective tool for promoting university entrepreneurship. Its main contributions can be grouped into the following aspects:

Increase in Entrepreneurial Culture and Skills Development

The model has fostered significant growth in students' entrepreneurial intent, strengthening their ability to identify business opportunities, manage resources, and face challenges in dynamic environments. The implementation of innovative pedagogical strategies and the integration of methodologies based on experiential learning have facilitated the development of key skills for the creation and consolidation of business initiatives.

Consolidation of the Entrepreneurial Ecosystem at the University of Guadalajara

Quantitative analysis revealed an increase in the university community's participation in entrepreneurship programs, reflecting a strengthening of the entrepreneurial ecosystem within the institution. The existence of a support network made up of incubators, innovation centers, and strategic allies has been decisive in this process.

Impact on Business Creation and Intellectual Property Registration

One of the most relevant findings of the study is the increase in the number of university startups and the registration of patents derived from entrepreneurial projects. The evidence suggests that the model has succeeded in catalyzing entrepreneurial activity in the university community, promoting the creation of innovative companies with high growth potential.

University–Business Linkages and the Triple Helix Model

Strengthening the interaction between universities, industry, and government has been another key achievement of the model. The participation of the productive sector in the design and implementation of entrepreneurship programs has enabled the effective transfer of knowledge and facilitated the entry of entrepreneurs into competitive markets.

Systematic application of continuous improvement

The model has adopted a continuous improvement approach based on the PDCA cycle, which has allowed for strategic adjustments on the basis of the results obtained and the emerging needs of the entrepreneurial ecosystem.

RECOMMENDATIONS

On the basis of the findings, the following recommendations are made to strengthen the model's impact:

- Diversification of funding sources: Explore alternative financing mechanisms, such as investment funds, crowdfunding, and strategic alliances with the private sector.
- Expanding the scope of the model: Implement strategies to expand the model to other university campuses, ensuring its replicability and adaptability to different contexts.
- Measurement of long-term impact: Develop longitudinal studies to evaluate the trajectory of university startups and their contribution to regional economic development.
- Strengthening links with the productive sector: Intensify collaboration with companies through mentoring, incubation, and acceleration programs for university startups.

The Model for Promoting University Entrepreneurship at the University of Guadalajara has proven to be a benchmark in the training of entrepreneurs and the consolidation of the university entrepreneurial ecosystem. Its impact on the creation of companies, links with the productive sector, and the promotion of an entrepreneurial culture demonstrate its relevance in the context of higher education in Mexico and Latin America.

However, to ensure its sustainability and expansion, it is essential to address the challenges identified and continue to improve the model. The experience of the University of Guadalajara offers valuable lessons for other institutions seeking to promote entrepreneurship as a central pillar of their educational mission, reaffirming the role of the university as a key agent in economic and social development.

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CONFLICT OF INTEREST

None.

AUTHORSHIP CONTRIBUTION

Conceptualization: Guillermo José Navarro del Toro, Benjamín Villegas Alcantar.
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