

# The Use of Partial Least Squares to Define the Characteristics in the Environment of Higher Education Institutions and their Effects on Entrepreneurial Academic Education, a Case Study: Torreon, Mexico

GONZÁLEZ FLORES KAREN MIRIAM<sup>1</sup>

<sup>1</sup>University of Debrecen, Faculty of Economic Sciences, Institute of Business and Management Sciences, kamiglez@econ.unideb.hu

*Abstract. Because universities have a favorable effect on student's entrepreneurial intents, Higher Education Institutions (HEIs) are essential to the delivery entrepreneurship education. By analyzing the perceptions of students who received master diploma in management-business fields in Torreon, Mexico in 2021, the aim of the research is to identify the internal and external aspects of the HEI environment and their impact on entrepreneurial education using Partial Least Squares methodology with the help of the SmartPLS software, 120 responses from the questionnaire. Three of the original hypotheses were confirmed, while four variables—two associated with HEI ecosystem external factors and two with entrepreneurial education elements—had to be removed since they were not accepted. The findings will lead to a better comprehension of the elements influencing master students' entrepreneurial perspective to create stronger relationship with elements of the HEI ecosystem.*

*Keywords: Entrepreneurship, Entrepreneurship Education, Entrepreneurship Ecosystem*

## Introduction

Mexico is not exempt from the worldwide phenomena of the increase of entrepreneurship in the past ten years, which has led to the arrival of institutions that do research and offer information to people looking to launch their own businesses.

In its broader sense, entrepreneurship is the process of making an idea into a business in order to acquire financial rewards. This idea is accomplished through innovation, which can occur in the form of new processes, business models, or even the development of new goods and services that revitalize the market and the worldwide economic system [1].

In similar context, the linkage of entrepreneurial activity to the process of creating value via transforming societal resources [2]. The business is viewed in this context as the tool that transforms existing inputs into outputs with monetary value.

The choice to start a business might result from one of two situations, each of them is influenced by the motivation of the individual [3]. As a result, the idea for a business is either inspired by someone who is unemployed or by someone who fears being unemployed, or it is motivated by someone who sees an opportunity. Entrepreneurship by opportunity versus entrepreneurship by need is the contrast that has been highlighted by Reynolds et al. [4] in their work.

Entrepreneurship by opportunity, on the other hand, occurs when equivalent acts are taken by employees, enrolled in school or college, or not actively seeking a job before who are wage/salary workers, and are educated in a college or university, or are not actively seeking a job prior to starting business.

The Higher education institution ecosystem factors foster the formation of opportunity initiatives as a result of the student's training in various academic subjects, where many ideas emerge, and the entrepreneurial spirit is triggered. Convincing examples include some of the world's most successful companies, such as Dropbox, Snapchat, Google, Microsoft, and Apple. Reflecting this, some institutions have departments dedicated to entrepreneurship that provide free services to their students, generally in the form of training and collaboration.

This investigation attempts to examine the Mexican university ecosystem, its external and internal factors and identify facts that make it easier the creation, survival, success, and failure of university entrepreneurial projects, as well as examine how it can be improved to provide greater opportunities for success to businesses that develop specifically in the Torreon's Mexico entrepreneurship ecosystem.

Furthermore, this study aims to assist HEIs in analyzing and reviewing their entrepreneurial academic programs and the influence they have on graduated master students. May be also be beneficial to other stakeholders in the region, such as investors, and corporations, who can identify or create prospective prospects for new enterprises or social, governmental, or environmental solutions.

## 1. Literature review

In recent years, the concept of "entrepreneurial ecosystem" has gained popularity, not only among business leaders and policy makers to promote growth-oriented entrepreneurship, but also among researchers and scholars in the field of management. But despite its popularity, there is still no definition of EE widely shared by academics and professionals since the lack of specification and conceptual limitations have made it difficult to understand this complex relationship [5].

If the notion of "entrepreneurial ecosystem" is analyzed separately, "ecosystem" is the first word that composes it. In biology, "ecosystem" is defined as a unit made up of interdependent organisms that share the same habitat, that is, it is the space that meets the appropriate conditions for the species to survive and reproduce.

The literature shows different definitions, but some ideas are common to all, such as: adequate conditions, interaction, interdependence, and feedback. Associated with the company and business, the term "ecosystem" was used for the first time by Moore [6] where mentions that business ecosystems gradually move from a possible group of elements to an association more structured. They are

concentrated outside the original frenzy of capital, customer interest, and talent generated by an innovation, as are successful species, the natural resources of sunlight, water, and soil nutrients [6].

This analogy reveals the complexity and diversity of the different actors, roles and environmental factors that interact to determine the entrepreneurial level of a locality or region [7]. There are numerous variables that determine its appearance and development, from a culture that allows the creation of favorable policies, accessibility to suppliers, clients or new markets, financing, human capital, natural resources, proximity to universities, technological support, and institutional support, as well as attractive living conditions [8].

The second term that makes up the expression "entrepreneurial ecosystem" (EE) refers to entrepreneurial activity. The theory of the innovative entrepreneur was created by Joseph H. Schumpeter, who focused on the vision of the entrepreneur, his main contribution was to consider the businessman as an innovator and his approach stated that in a balanced situation, companies remunerate all productive factors and obtain a normal profit derived from their activity. When the entrepreneur, promotes the process of technological advance, breaks this equilibrium thanks to innovation, he generates extraordinary profitability until he returns to a new equilibrium situation, where he returns to ordinary profit. In this technical process that generates economic development and social advances, [9].

According to the reviewed literature [10, 11, 12], a business ecosystem contains and promotes entrepreneurial activity in a certain geographical area. It is a collection of complex linkages that exist between entities and entrepreneurs and their technological, academic, social, political, and economic contexts, and it promotes the growth of entrepreneurial endeavors [13]. According to Berger [14], these entrepreneurial ecosystems feature two sorts of networks: an open network that connects entrepreneurs with customers, suppliers, and other support groups, and a closed network that allows them to transmit their ideas and issues in search of guidance or criticism [15].

One of the first authors to define the components of the ecosystem, or what he calls domains, was Isenberg [10], just as the term ecosystem, which its origin comes from biology, it was incorporated into the business world, for example the concept of domain is used by biologists as a classification system that allows naming and grouping in a logical, objective, and non-redundant manner. The elements are represented through a model that emphasizes the circularity and interconnection that the different domains employ among themselves. Thus, the author identifies as such: Politics, Culture, Market, Finance, Human Capital, and Support (Figure 1).

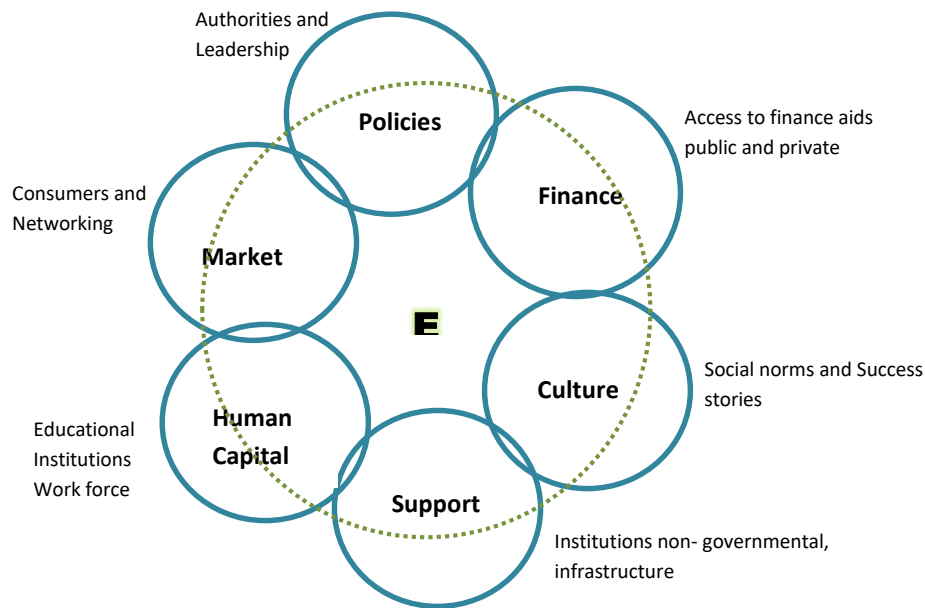


Figure 1. The Domains of the Entrepreneurship Ecosystem (EE) adapted from Isenberg, [10].

Isenberg [10] mentioned in his work that each ecosystem is unique and, although the same criteria are considered to determine it, the matrix derives from the interaction of several elements in a very complex way, which makes it impossible to use generic templates. For its own, authors like Brown and Mason [16] warned that the rise of an EE depends on the peculiarities that each region has in a singular way, due to the existence of unique factors that are difficult to replicate. Neck and Greene [17] also agreed with this difficulty of reproducing and managing an ecosystem from one region to another based on their study carried out in the town of Boulder, Colorado, United States.

Therefore, from now on for this research is important to address that the concept of entrepreneurship ecosystem will be describing and representing the Universities /HEIs themselves as entrepreneurship ecosystems, based on the previous definitions concluding that fundamentally any geographical place can be considered as entrepreneurship ecosystem as long as encourages, connects, and supports entrepreneurial activities between the different stakeholders of the ecosystem.

As a result of the preceding statements, entrepreneurs are looking for initiatives from entrepreneurship ecosystem stakeholders to help them establish and grow their businesses therefore the need to research Higher Education Institutions (HEI) ecosystem factors and their influence in the preparation of master graduated students (typically between the ages of 24-46) becomes a key reason in the development of the entrepreneurial ecosystem in Mexico, whether to start their own business or to get a job. As a result, this study will address the need to answer research questions and provide solutions primarily for educators as well as stakeholders in the entrepreneurial ecosystem.

Entrepreneurial ecosystems emphasize the synergies that exist between the entrepreneurial process and the community's environment; they are a policy instrument that can assist regions in catalyzing a sustainable economy led by entrepreneurship and other stakeholders. Internal entrepreneurship systems, for their part, examine how researchers and teachers approach the task of more thoroughly

researching what must be done to develop the entrepreneurial spirit in their students and ensure the success of their projects. Universities and colleges may always do more to help their students develop entrepreneurship, intention, and excellent career choices in general. Ideally, it would provide an experience framework for students to test their entrepreneurial ideas with the assistance of professors, practitioners, local entrepreneurs, and others.

An entrepreneurial university is defined as an establishment that attempts to balance a wide range of external circumstances with institutional responses while retaining academic quality [18]. This can be difficult because schools are increasingly being asked to address solutions for local and regional problems, while at the same time are affected by the plans of numerous stakeholders [19, 20]. Saying this means that the universities, have insufficiently flexibility to take on external demands and problem solving, mostly if they have a traditional academic infrastructure [18]. As a result, this highlights the importance of institutionalized ways for engaging the community participation.

In the work of Mukesh and Rajasekharan [21] they conducted a detailed investigation in Karnataka, India, where they examined the impact of HEI ecosystems on entrepreneurship education (EEd) and attempted to map the complicated relationship between both. They discovered six EEd elements and eight HEI ecosystem factors using exploratory factor analysis; the final four were classified as external factors and the other four as internal factors in their research combine the qualities of Guerrero and Urbano [22] and Pittaway and Cope [23] results of their study to produce an integrated theoretical framework that explains the synergy between the HEI ecosystem and EEd.

Corresponding to Guerrero and Urbano, [22] in their work defined a framework of the entrepreneurial universities, which for this research their model is a foundation for defining the variables of the HEIs ecosystem, in their study they divided it in Formal and Informal and Internal as part of the environment but separated at the same time, for this research have been modified to and will be called External and internal factors.

The following variables are included in the HEIs ecosystem are subdivided in two groups external and internal, the first one includes: entrepreneurship promotional activities, attitude towards entrepreneurship, support for entrepreneurship, governance structure; the internal factors in the HEIs the ability to connect start-ups with industry; teaching and personnel; physical infrastructure and facilities; and financial assistance for entrepreneurship [21, 22].

For the variables in the entrepreneurial education that will be consider for this study: the degree of entrepreneurial education in academic program, extracurricular activities, department philosophy on entrepreneurship, mentoring and coaching programs for entrepreneurs, the student orientation, this conceptual framework was retrieved from the work of Pittaway and Cope [23], and the variable entrepreneurial teaching methodologies from Guerrero et al. [22].

As an result of the information presented, the following hypotheses can be proposed:

H1: The stronger connection of the External factors of the HEIs, the stronger relationship the Internal factors of the HEIs.

H2: The higher the level of interconnectedness of entrepreneurship education in HEIs, the higher the level relationship of the external factors in HEIs.

H3: The higher the level of interrelation the entrepreneurship education in HEIs, the higher the level of interconnectedness the internal factors in HEIs.

## 2. Problem statement

Mexico's economy and labor market have both dropped significantly, leading in an increase in entrepreneurial activity. According to the National Institute of Statistics and Geography (INEGI), "23% of Mexicans start a business out of necessity, while the remaining 77% do so because there are available opportunities" [24]. Because there are few opportunities for a high-quality existence in the national labor market, entrepreneurs are forced to seek funding or specialized training. This emphasizes the importance of understanding the factors that impact entrepreneurship and the supportive measures that might help entrepreneurial endeavors succeed. According to Villa, et al. [25], entrepreneurs in Mexico are becoming more inclined to self-employment to improve their quality of life.

Although the number of startups increased as a result of the epidemic, a significant number of these businesses fail in their early phases. Mexico is one of the Latin American countries which, despite an increase in projects more enterprises closed than the number created in 2020 and 2021. According to data from the National Institute of Geography and Statistics, 24% new companies opened in Mexico in 2021, in contrast to 33% of the surviving establishments failed or disappeared in 2020 [26].

As an outcome of the above statements, entrepreneurs are looking for support by the entrepreneurship ecosystem's stakeholders to help them to establish and grow their own companies. As a result, the need to research HEIs ecosystem's factors and their influence in the preparation of master graduated students (typically between the ages of 24-46) it becomes a key reason in the development of the entrepreneurial ecosystem in Mexico, whether to start their own business or to get a job. As a result, this study will focus on the requirement to undertake the aims of this research, primarily directed for educators but also for stakeholders in the entrepreneurial ecosystem.

## 3. Aims of the research

This research focuses on assessing the influence of Higher Education Institutions (HEIs), in particular, the research objectives are:

- Explore the internal, external HEI factors and entrepreneurship education factors that influence master graduate students in applying for a degree in business/management fields in Torreon, Mexico
- Explore the entrepreneurship education factors influence the entrepreneurship mindset of the graduated students in Torreon, Mexico.
- Create a new framework of the higher education ecosystem factors and their relationship with the entrepreneurial education to be applied in Torreon, Mexico.

## 4. Methodology

This research project explored two key variables in higher education institutions in Torreon, Mexico, one called the External factors in HEIs and the other Internal factors in HEIs, to assess their impact on Entrepreneurship Education in HEIs.

There were two forms of research in this project: one qualitative (exploratory and descriptive) and one quantitative (relational, explanatory, and predictive). It was based on documentary sources, fieldwork, questionnaires, and the researchers' personal experiences.

Was created a survey based on the Literature Review consulted constructed on the theories used [21, 22, 23], were adapted to be able to reach the aim of this research as previously was detailed.

To carry out this research, a questionnaire was created and circulated through email in the first quarter of 2022. The case study was limited to graduates who obtained a master's degree in Torreon, Coahuila, between 2020 and 2021. The questionnaire was distributed to 156 recipients with the help of the "follow-up graduates' program" department in each faculty. Six private and one public college or university were chosen for the study, all of providing master's degrees in fields such as economics, management, business, and finance. The number of participants exceeded the 111 required for a 95% confidence level, which is sufficient for statistical computations in the results and discussion sections.

The questionnaire utilized was a multiple-choice design based on the literature study. All of the answers are connected to entrepreneurial ecosystem factors, and the questions are structured as closed questions. Students were asked to rate their degree of agreement on a Likert scale of 1 to 5, with 5 indicating total agreement and 1 indicating complete disagreement. The Sample Size Calculator (calculator.net) was used to calculate the sample size. The formula was created using data from Mexico's National Association of Universities and Higher Education Institutions (ANUIES) [27].

The figure 2 shows the variables used for the creation of the questionnaire, regardless of utilizing the same method, the names of the factors F1 and F2 have been adjusted for this specific research.

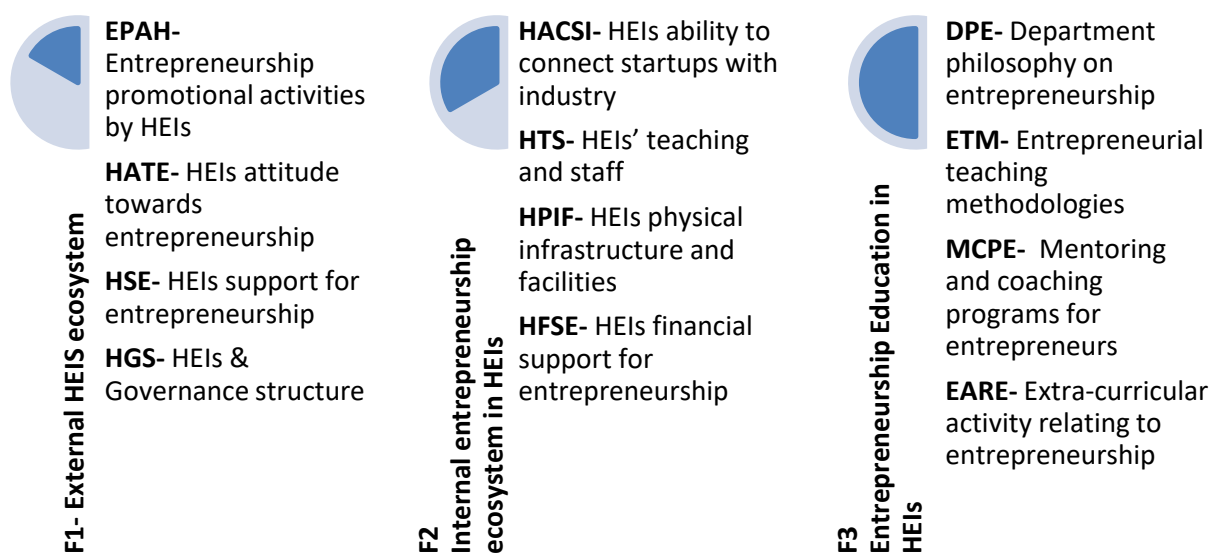


Figure 2. Variables for the questionnaire. Retrieved from González Flores et al. [15]

In the Figure 3 is illustrated the structural equation model, 3 hypotheses are displayed; "the inner model specifies the relationships between the independent latent variables, whereas the outer model specifies the relationships between the latent variables and their observed indicators" [28].

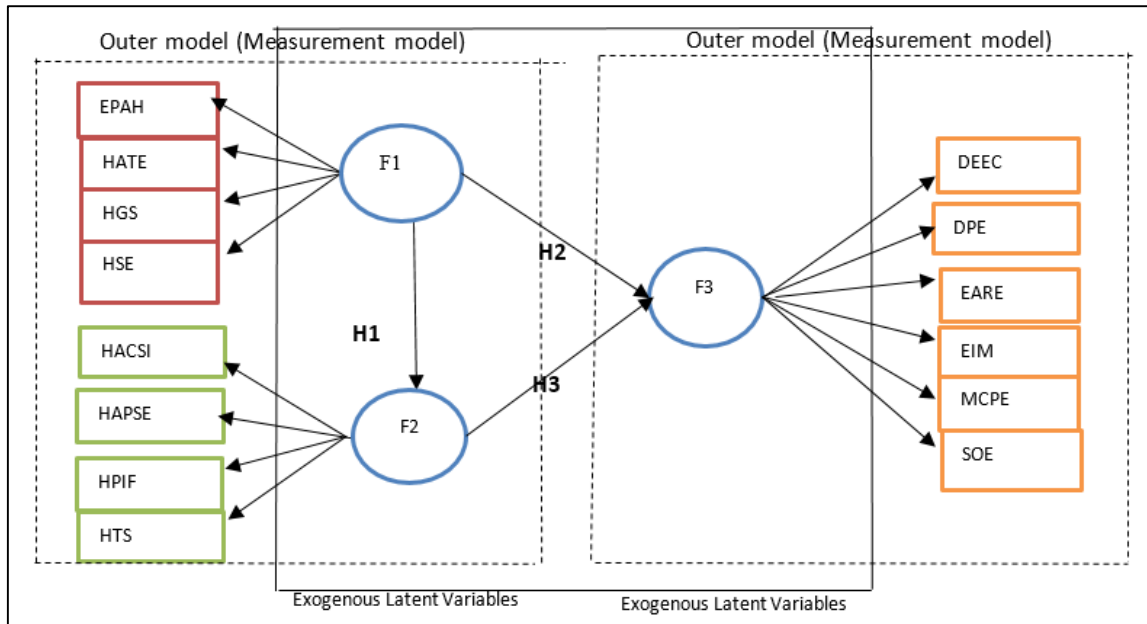


Figure 3. Structural model based on the conceptual framework González Flores et al. [15]

#### 4.1. Case of study and data collection

This study will only include graduates from master’s degrees in business, management, or finance, as well as those who had an entrepreneurial subject implemented in their academic studies. The author was most interested in learning the graduates’ opinions and views regarding their Higher Education Institution ecosystem variables as well as the entrepreneurship education elements that assisted to boost or reduce their entrepreneurial mentality in a holistic approach. This study will employ a case study of graduates from 2020 to 2021 in North-East Mexico (Torreón, Coahuila Mexico).

The sample calculations table 1, were performed using the following formula: The Universe population = totally concluded the academic master program + graduates (who earned the master's degree) during 2020-2021. The information was gathered from the ANUIES Report 2021 [27]

Concept	Percentage	Number
Confidence Level:	95%	
Margin of Error:	5 %	
Population Proportion:	44 %	
Population Size:	-	156
Result Sample size	-	111

Table 1. Population Sample. Retrieved from: González et al. [15]

## 4.2. Indicator reliability

The figure 4, shows the Histogram Outer Loadings, where two of the variables of the factor F1 External entrepreneurship ecosystem and two of Entrepreneurship Education in HEIs were discarded for having factorial load values below 0.7.

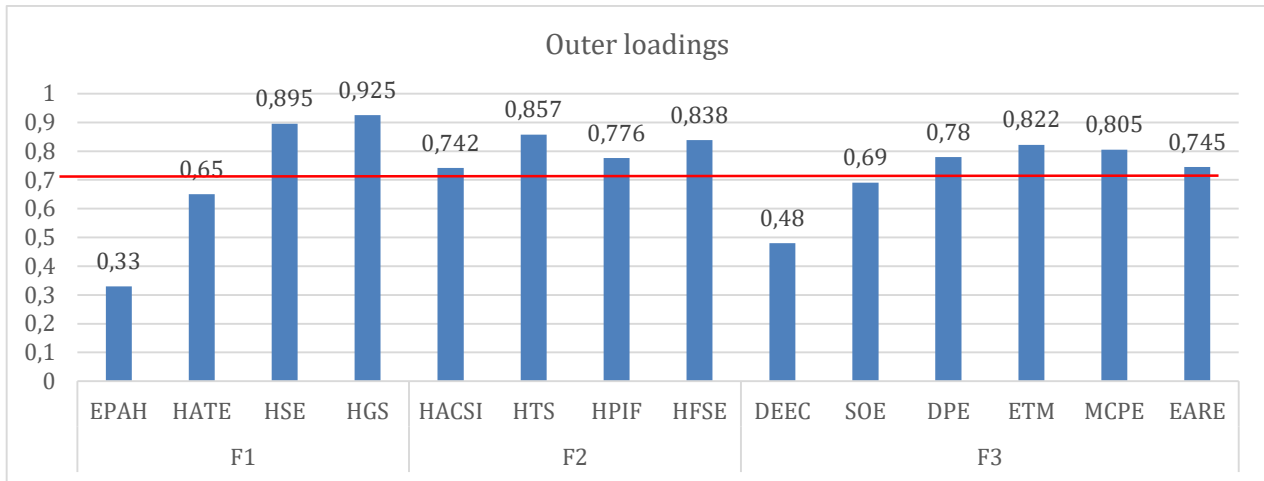


Figure 4. Source: Retrieved from González Flores et al. [15]. Discarded variables: EPAH, HATE, DEEC and SOE

In this table 2, the four variables that were eliminated for having a low factor load no longer appear. "AVE" number should be 0,5 or higher. [15]

Latent Variable	Indicators	Loading	Indicator reliability (Loading <sup>2</sup> )	alpha de Cronbach	rho_A	(IFC)	(AVE)
F1	HGS	0.925	0.855	0.795	0.81	0,753	0,676
	HSE	0.895	0.801				
F2	HACSI	0.742	0.55	0.817	0.82	0,43	0,205
	HFSE	0.838	0.702				
	HPIF	0.776	0.602				
	HTS	0.857	0.773				
F3	EARE	0.745	0.555	0.821	0.839	0.405	0.165

Table 2: Convergent validity. Retrieved from González Flores et al. [15]

## 4.3. Discriminant validity test

In the table 3 according to the work of Fornell and Larcker [29] they suggest that the "square root" of AVE of each latent variable should be greater than the correlations among the latent variables in this research this criterion is supported.

	F1	F2	F3	
F1	0,91	0,911		
F2	0,809	0,804	0,809	
F3	0,723	0,801	0,779	0,803

Table 3: Discriminant validity. Retrieved from González Flores et al. [15]

## 5. Results

The suggested relationship model was compared, and the coefficient of determination ( $R^2$ ) and prediction validity of the model ( $Q^2$ ) were calculated. The coefficient of determination of the independent or endogenous variables must be equal to or larger than 0.1 [30]. The Blindfolding approach was used to determine the predictive validity of the dependent constructs.

According to Hair et al. [30], mention that the coefficient of determination of endogenous or dependent variables ( $R^2$ ) values of 0.25, 0.50, and 0.75 have low, medium, and high importance, respectively. According to Stone [31] and Geisser [32], the value of the coefficient ( $Q^2$ ) defines the prediction quality of the structural model. The Blindfolding approach is used to create this test, which is utilized as a standard to measure the predictive significance of the dependent constructs. A value of  $Q^2$  greater than zero suggests that the model is predictive [33].

According to González et al. [15] in the table 4 shows how the  $R^2$  value for the entrepreneurship education construct is 0.645, which means that the F3 factor explains 64.5% of the variance of F1 and F2. Based on this empirical criterion, all the constructs have acceptable predictive power and in all of them, the  $Q^2$  values are positive.

Construct	$R^2$	$Q^2$
Internal entrepreneurship ecosystem HEIs	0,758	0,387
Entrepreneurship education	0,645	0,359

Table 4. Explained variance and predictive validity of the model. Retrieved from González Flores et al. [15]

From the work of Vinzi et al. [34] suggest a global goodness-of-fit criterion for PLS structural models and hypothesis testing, they propose that the global goodness-of-fit index be calculated by multiplying the square root of the arithmetic mean of the extracted variance analysis (AVE) by the arithmetic mean of the coefficient of determination ( $R^2$ ) of the endogenous or dependent variables.

In the work of González Flores et al. [15] mentions that the PLS methodology does not adopt that the information is generally dispersed, which means that, to measure the quality of the whole model, it is required to apply a non-parametric resampling method called bootstrapping, which implicates random resampling with replacement of the original sample, generating novel quasi-samples from the original, to obtain sampling errors for hypothesis testing [35].

After the reliability and validity tests of the measurement model have been verified and the path coefficient is adequate, the bootstrapping or resampling process was performed. Re-sampling positively validates the three hypotheses in table 5[15].

Hypothesis	Trajectory/Path	Trajectory coefficient *p<0,05; **p<0,01; ***p<0,001	"t" value
H1	F1 External HEIs ecosystem → F2 Internal ecosystem	0.000***	11.959
H2	F1 External HEIs ecosystem → F3 Entrepreneurship education	0.000***	19.701
H3	F2 Internal HEIs ecosystem → F3 Entrepreneurship education	0.000***	5.515

Table 5. Hypotheses trajectory coefficients. Retrieved from González Flores et al. [15]

The explanation from the table 5 the "t" values of the resampling process for the external model, shows that all the loadings are significant, which supports the conclusion of the reliability of the measurement model and the convergent validity. The results indicate that in the conceptual model, the adequate management of the external HEIs ecosystem has a positive influence on the internal HEIs ecosystem, since (H1:  $\beta = 0.871$ ,  $p = 0.00$  and  $t = 11.959$ ) with which the hypothesis H1 is accepted. It is also verified that the external HEIs ecosystem has a positive influence in entrepreneurship education, because (H2:  $\beta = 0.102$ ;  $p < 0.001$  and  $t = 19.701$ ) H2 is confirmed. Finally, the internal HEIs ecosystem has a positive influence on Entrepreneurship education (H3:  $\beta = 0.712$ ,  $p < 0.01$  and  $t = 5.515$ ), and hypothesis H3 is also accepted [15].

Despite the fact the H1 and H2 were accepted, as a consequence of removing HATE and EPAH (HEIs attitude towards entrepreneurship and Entrepreneurship Promotional Activities in HEIs) in the HEIs Ecosystem factors, Isenberg [10] warns that the ecosystem consists in a group of individual factors that are combine in a complex way; individually, each of these factors drives entrepreneurship, but they are not sufficient to maintain it. However, if all are combined in a comprehensive system might speed the formation and growth businesses.

Even though both variables DEEC and SOE (Degree of entrepreneurial education in curriculum and student orientation on entrepreneurial activity,) were eliminated in factor F3, Hypothesis H3 was still accepted, because this case of study in Torreon, Mexico, the master's graduated students were not able to recall specifically entrepreneurial education in their academic programs neither the variable about orientation towards entrepreneurship as main subjects of their academic programs, but the rest of the variables (philosophy department on entrepreneurship, teaching methodologies, mentoring and coaching, and extracurricular activities programs) had positive results among the participants.

## 6. Conclusions

The following main conclusions can be generated:

- Through an analysis of the perceptions of the master graduated in management-business areas of Torreon, Mexico in 2021, perceptions the research presented complements to the understanding the study and demonstrates the internal and external factors of the ecosystem of higher education institutions and their impact on entrepreneurial training.

- Due to the significance of fostering an entrepreneurial culture, the method utilized has been designed to significantly decrease the examination and implementation time, allowing the replication of this research in other cities in Mexico or even in other countries.
- The findings of the applied approach and those obtained using the Partial least squares (SmartPLS) methodology to test the hypotheses are consistent within statistically acceptable parameters.
- The methods applied, and the sample examined can be applied to other higher education institutions or universities, to expand entrepreneurship education in their academic curricula and to other stakeholders within the ecosystem like the teachers, researchers, counsellors, or any other person involved in the development of the matter.
- Founded on the research's findings, it was determined that the higher education institutions can improve the entrepreneurial ecosystem's internal and external factors if they include in a more consistent way the subject of entrepreneurship education, this might help to improve the regional entrepreneurship ecosystem.

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