Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v11i21.757

Artículos Científicos

Nivel de la capacidad para el emprendimiento en estudiantes de ingeniería y arquitectura de una universidad pública del sureste de México

Capacity Level for Entrepreneurship in Engineering and Architecture Students of a Public University in Southeastern Mexico

Nível de capacidade de empreendedorismo em estudantes de engenharia e arquitetura de uma universidade pública no sudeste do México

María del Carmen Sandoval Caraveo
Universidad Juárez Autónoma de Tabasco, México
maria.sandoval@ujat.mx
http://orcid.org/0000-0002-5482-3032

Edith Georgina Surdez Pérez*
Universidad Juárez Autónoma de Tabasco, México
edith.2109@hotmail.com
http://orcid.org/0000-0001-8731-9273

Abraham Gerardo Pérez Sandoval
Universidad Juárez Autónoma de Tabasco, México
lcp_sandoval88@hotmail.com
http://orcid.org/0000-0003-0657-3021

*Autor de correspondencia

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Resumen

Debido a que promueve la creación de empresas y del empleo, el emprendimiento es una actividad relacionada con el crecimiento económico. De ahí que en los últimos años las instituciones de educación superior hayan introducido esta temática dentro de sus programas educativos. El objetivo de esta investigación fue establecer la capacidad para el emprendimiento en estudiantes de ingeniería y arquitectura de una universidad pública del sureste de México. El método utilizado fue cuantitativo, de tipo descriptivo, con diseño no experimental transversal y alcance correlacional. La población participante fue de 3227 alumnos matriculados en los programas de ingeniería Mecánica Eléctrica, ingeniería Civil, ingeniería Eléctrica y Electrónica, ingeniería Química y Arquitectura. A partir de un muestreo aleatorio simple, la muestra fue de 343 estudiantes. Se aplicó al instrumento un análisis factorial confirmatorio a través del programa SPSS Amos, que comprobó un modelo sustentable de medición del constructo con tres factores: personal, recursos y social. El alfa de Cronbach reportó una confiabilidad de $\alpha = 0.868$. Los resultados mostraron que 26 % de los estudiantes considera no tener capacidad emprendedora y 23 % poca facultad para ello. La estadística descriptiva reveló que las capacidades de emprendimiento de la muestra no son contundentes en ninguno de los factores analizados. La prueba *post hoc* de Bonferroni reveló diferencias significativas al comparar las capacidades emprendedoras entre los estudiantes de los programas educativos. Los participantes de ingeniería Mecánica Eléctrica mostraron mayor potencial para el emprendimiento. Asimismo, los alumnos de sexto y séptimo semestre y los que tienen 23 y 24 años poseen más capacidades de emprendimiento. No se encontraron diferencias significativas entre hombres y mujeres ni correlaciones importantes con la edad, el semestre y las calificaciones de los estudiantes. En conclusión, existe la necesidad de diseñar estrategias que coadyuven a robustecer las capacidades de emprendimiento en los sujetos de estudio por no encontrarse bien definidas.

Palabras clave: capacidad para el emprendimiento, empresa, ingeniería, universidad.

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Abstract

Because it has a key role in the creation of enterprises and jobs, entrepreneurship is an activity deeply related to economic growth. That is why, in the last couple of years, higher education institutions have introduced this subject in their academic programmes. The aim of this investigation was to establish the level of entrepreneurship in engineering and architecture students of a public university in Mexico. The method used was a quantitative approach of the descriptive type with a non-experimental, transversal and correlational design. The participating population consisted of 3227 students enrolled in either Electric Mechanic Engineering, Civil Engineering, Electric and Electronic Engineering, Chemical Engineering or Architecture. The sample of 343 students was obtained through a simple random sampling method. A factorial confirmatory analysis was applied to the instrument through the SPSS Amos program, which proved to be a sustainable model to measure a three-factor construct: personal, resources and social. The Cronbach's alpha test presented a reliability of $\alpha = 0.868$. The results showed that 26 % of the students consider no to have the ability to be entrepreneurs and that 23 % have little ability. The descriptive statistic revealed that the abilities are not well defined in any of the analyzed factors. Bonferroni´s *post hoc* analysis demonstrated the significant differences when comparing the abilities between the students of these academic programmes. Students of Electric Mechanic Engineering have more potential to be entrepreneurs, as well as students in sixth and seventh semester and those in the 23 to 24-year-old range. No significant differences were found among men and women nor do important correlation with age, semester and grades. Therefore, it is concluded that it is necessary to design strategies to contribute to strengthen the, not well determined, abilities to be entrepreneurs on the subjects of this study.

Keywords: entrepreneur, business, engineering, university.

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Resumo

Por promover a criação de negócios e empregos, o empreendedorismo é uma atividade relacionada ao crescimento econômico. Assim, nos últimos anos, as instituições de ensino superior têm introduzido esse tema em seus programas educacionais. O objetivo desta pesquisa foi estabelecer a capacidade de empreendedorismo em estudantes de engenharia e arquitetura de uma universidade pública do sudeste do México. O método utilizado foi quantitativo, descritivo, com delineamento transversal não experimental e escopo correlacional. A população participante foi de 3.227 alunos matriculados nos programas de Engenharia Elétrica Mecânica, Engenharia Civil, Engenharia Elétrica e Eletrônica, Engenharia Química e Arquitetura. A partir de uma amostragem aleatória simples, a amostra foi de 343 alunos. Uma análise fatorial confirmatória foi aplicada ao instrumento por meio do programa SPSS Amos, que verificou um modelo sustentável de mensuração do construto com três fatores: pessoal, recursos e social. O alfa de Cronbach relatou confiabilidade de α = 0,868. Os resultados mostraram que 26% dos alunos consideram não ter capacidade empreendedora e 23% pouco corpo docente para isso. A estatística descritiva revelou que as capacidades empreendedoras da amostra não são conclusivas em nenhum dos fatores analisados. O teste post hoc de Bonferroni revelou diferenças significativas ao comparar as habilidades empreendedoras entre alunos em programas educacionais. Os participantes da Engenharia Elétrica Mecânica apresentaram maior potencial de empreendedorismo. Da mesma forma, os alunos do sexto e sétimo semestres e os de 23 e 24 anos apresentam maior capacidade empreendedora. Não houve diferenças significativas entre homens e mulheres ou correlações significativas com a idade, semestre e notas dos alunos. Conclui-se que existe a necessidade de desenhar estratégias que ajudem a fortalecer as capacidades empreendedoras dos sujeitos do estudo por não serem bem definidas.

Palavras-chave: empreendedorismo, negócios, engenharia, universidade.

Fecha Recepción: Enero 2020 **Fecha Aceptación:** Agosto 2020

Introduction

The term entrepreneur comes from the French entrepreneur and arises at the beginning of the 16th century in order to name those who were related to the military field. In the 18th century, the French applied the concept to architectural professionals and those involved in building bridges. In economic matters, the term was defined by Richard Cantillon in 1755 as "the process of facing uncertainty" (Hidalgo, 2014, p. 47). The English word entrepreneurship can be conceived as 'entrepreneurship', 'entrepreneurship', 'entrepreneurial spirit' or 'entrepreneurship' (Gutiérrez, 2011).

The entrepreneur is an individual who starts an economic, social or political activity. The entrepreneurial entrepreneur "is a person who identifies a business opportunity and organizes the necessary resources to start it up" (Hidalgo, 2014, p. 47). From the economic perspective, an entrepreneur must use the production elements of labor, knowledge, technology, management, and capital to engage in production activities. The functions of an entrepreneur are different from those of an employee: he provides production elements, he combines production elements to produce something (Chen et al., 2013).

The entrepreneur can be analyzed through three perspectives. The first includes the theories of motivation, traits and the so-called cognitive psychological; the second refers to the relationship with business family history, and the third relates entrepreneurship to attitudes, it has to do with the individual's interest in carrying out entrepreneurial activities, which is considered the main factor of the entrepreneurial profile (Cabana, Cortés, Plaza, Castillo and Álvarez, 2013).

Sanabria, Morales and Ortiz (2015) mention that entrepreneurship is "the combination between the attitude and the capacity of the person that allows them to carry out new projects of any kind, generally creative" (p. 119). It has also been described as a factor related to the development of the economies of the countries through the promotion of jobs and the growth of small companies. Hence, there has been an increase in research in the academic field on this topic and a greater interest on the part of government institutions in promoting entrepreneurial activities. (Berríos, 2017).

In this regard, Hatt (2018) mentions that among the entrepreneurship conceptualizations none is sufficient by itself, since many people with apparently entrepreneurial traits have not established new companies and others who have been company founders do not show an entrepreneurial approach.

For a company to emerge, in the first place there must be an entrepreneurial intention, that is, "the self-recognition of the conviction of creating a business and conscious planning for its realization in a future time" (Soria, Zuniga and Ruiz, 2016, p. 26). The same Soria et al. (2016) point out that the values of an individual, as well as their cultural, family, social and educational environment, influence their interest in creating a company.

In this sense, Sánchez, Caggiano and Hernández (2011) believe that entrepreneurial skills should be taught from an early age until reaching the university level, considering that the individual's aptitudes and personality represent important factors for success and that the university Due to its proximity to the labor market and because it is a space that generates knowledge, it is in an important place to promote entrepreneurship in students. Sánchez et al. (2011) add that entrepreneurial education, coupled with a positive attitude of young people aimed at creating businesses, encourages the incubation of new business forms, where science and technology are protagonists.

Taking into account all of the above, researchers and society in general have increased their interest in the last decades in understanding the promotion of entrepreneurship and the role of universities in economic and social development (Guerrero et al., 2016). In such a way that, according to the relevance of higher education institutions in the social and economic development of the countries, in recent years they have included the theme of entrepreneurship within their educational programs and activities to promote the entrepreneurial spirit in students. (Cantillo, Piña, Gómez and Volpe, 2013; Sanabria et al., 2015).

Following Núñez and Núñez (2016), education at school should be aimed at promoting entrepreneurship due to the fact that entrepreneurs contribute significantly to economic growth, and can be done by including subjects that promote entrepreneurial education and are directed towards creation of companies (economic purposes), or disseminate it in the curricula with the purpose of adopting an interdisciplinary approach aimed at carrying out social or productive projects.

Thus, universities must be supported to play a key role in promoting entrepreneurial development. The teacher, for his part, must prepare himself for this new form of teaching that entails establishing pedagogical actions, real changes in teaching practice, which translate into constant participation and training aimed at developing skills related to entrepreneurship (Vera

et al. 2008). For entrepreneurship, according to Chen et al. (2013), education aims to cultivate business awareness, thinking, and skills through educational methods.

In this order of ideas, globalization demands entrepreneurial individuals who respond to the needs of new knowledge, where higher education institutions play a preponderant role in education for entrepreneurship both in favorable circumstances and in the risks implicit in the activity of entrepreneurship. Thus, education, in addition to promoting the development of skills for the creation of companies, must tend towards the motivation of each individual to promote entrepreneurial actions (Osorio and Pereira, 2011). Promoting entrepreneurship and educating towards entrepreneurship is one way to increase the number of entrepreneurs to stimulate economic growth (Rauch and Hulsink, 2015).

There are studies that have highlighted the importance of fostering this entrepreneurial spirit in higher education institutions, such as that of Cabana et al. (2013), who analyzed, through a quantitative study, the entrepreneurial capacities in higher education students. For the research in question, four factors were considered: attributes of the entrepreneur, interpersonal capacities, capacities in the face of risk and attitudes. The sample consisted of 389 students from eight degrees assigned to private universities, institutes and technical training centers. The results show that students have an advanced level of entrepreneurial skills as a result of the teaching-learning process and the organizational culture aimed at promoting entrepreneurship in higher education centers. Cabana et al. (2013) concluded that students have the conditions to develop and implement business opportunities.

Other research on entrepreneurial skills in higher education is that of Rauch and Hulsink (2015), whose objective was to identify whether education for entrepreneurship has effects on business behavior. The findings of this quasi-experimental study indicate that when there is participation of those involved, there is an increase in entrepreneurial attitudes and greater business intentions are shown at the end of the program. And they confirm that education for entrepreneurship is associated with the creation of new businesses.

It is also worth mentioning the study carried out by Alvarado and Rivera (2011) with 255 students from the economic and administrative areas in a college in Colombia. This pair of authors carried out an exploratory research with a mixed approach to identify the characteristics of entrepreneurship in the aforementioned population. Their findings suggest that three-quarters of students show interest in starting business activities. In terms of gender distribution, they identified that there is a balance in this propensity. In addition, when

discovering that more than half come from families with their own businesses, they suggest that entrepreneurship has a relationship with the family environment. In the conclusions section, Alvarado and Rivera (2011) emphasize that the university must promote the entrepreneurial initiatives of its students through an adequate structure of its study plans and programs to contribute to the economic development of the regions.

The findings found in these studies show that the university, through its learning processes, has an outstanding role in the development of entrepreneurial capacities and in the creation of companies. However, these efforts have been made mostly with students from economic and administrative areas, so there is, then, the need and relevance to carry out research with students who are studying other educational programs at the higher level to determine differences and similarities and, consequently, have a broader panorama of entrepreneurial behavior in the university population.

For these reasons, the objective of this research was to establish the level of entrepreneurship capacity in engineering and architecture students from a public university in southeastern Mexico.

Materials and methods

Participants

The population was made up of engineering and architecture students from a public university located in the Mexican southeast. Out of a total population of 3,227 students, 343 were surveyed. Participants were selected through simple random sampling. The number of participants for each of the educational programs was calculated proportionally based on the total number of students. To apply the research instrument, the insertion criterion was that they study from the fourth semester onwards, considering these students with more experiences within the university.

The study included 81 students of Electrical Mechanical Engineering, 84 of Civil Engineering, 30 of Electrical Engineering, 65 of Chemical Engineering and 83 of Architecture. The ages ranged from 19 to 26 years old. Among those 19 to 20, there were 78 (22.7%); from 21 to 22, 156 (45.5%); between 23 and 24, 88 (25.7%), and between 25 and 26 years, 21 (6.1%) (M = 21.92, SD = 1.69). In terms of gender and status, 272 (79.3%) were men and 71 (20.7%) were women; 312 (91%) were single and 31 (9%) were married. In relation to the semester, 95 (27.7%) were in the fourth and fifth; 89 (25.9%) the sixth and

seventh; 99 (28.9%) the eighth and ninth, and 60 (17.5%) the tenth and eleventh semester. The average in the grades ranged from 7 to 10: 84 (24.5%) had between 7 and 7.9; Another 232 (67.6%) had an average of 8 to 8.9 (67.6%) and 27 (7.9%) had scores between 9 and 10 (M = 8.19, DT = 0.489).

Instrument

The adaptation made by Pérez (2019) of the instrument designed by Cabana et al. (2013) to measure entrepreneurial abilities in university students. Pérez (2019) made changes to the wording so that the items were on a Likert-type scale and in a positive sense. This version consisted of 22 items, with five response options: "Totally disagree" (0), "Disagree" (1), "Neither agree nor disagree" (2), "Agree" (3) , "Totally agree" (4). The author Pérez (2019) reported a construct validity through an exploratory factor analysis with three factors: personal, resources and social.

To contextualize the validity of the instrument to the population of engineering and architecture students reported in this work, it was decided to apply a confirmatory factor analysis, which verified a sustainable measurement model. This test yielded 18 items, the adjustment measures are reported in Table 1.

Tabla 1. Pruebas de bondad de ajuste

Medidas	**Valor favorable**	**Valor obtenido**
La razón de ji al cuadrado sobre los grados de libertad	< 2.1 y 3	2.43
Índice de bondad de ajuste	≥ 0.90	0.906
Índice de Tucker Lewis	> 0.90	0.908
Índice de ajuste comparative	0.90 0.95	0.921
Error cuadrático medio de aproximación	< 0.05 a 0.08	0.060

Fuente: Elaboración propia

The reliability of the instrument was verified through Cronbach's alpha, which reported acceptable values for each of the factors. The result is presented in Table 2.

Tabla 2. Confiabilidad del instrumento

Factor	**Alfa de Cronbach**
Personal	0.836
Recursos	0.700
Social	0.787
Confiabilidad total	0.868

Fuente: Elaboración propia

The definitions of the factors are shown in Table 3.

Tabla 3. Definición de los factores de la variable capacidades de emprendimiento

Factor	**Definición**
Personal	Capacidades de los estudiantes para concebir y hacer prosperar un negocio.
Recursos	Opinión o creencia del estudiante acerca de los apoyos que le proporcionan los profesores y la universidad para promover el emprendimiento.
Social	Es la importancia que el estudiante le da a las opiniones de sus compañeros con relación a su determinación por emprender un negocio.

Fuente: Elaboración propia con base en Pérez (2019)

Data collection procedure

Data collection was done in the cafeteria, classrooms, and university labs. Paper and pencil were used. The students were informed that they should not write their name on the questionnaire to preserve their anonymity and obtain accurate information. The data were analyzed through descriptive, inferential and correlation statistics with the SPSS statistical package.

Results

In the frequency analysis, the data showed a normal distribution with a minimum value of 0.72 and a maximum value of 12; a kurtosis of 1.706, a skewness of -0.635, a mean of 8.27, a median of 8.31, a mode of 7.96, and a standard deviation of 1.67.

Entrepreneurship capacities were determined by classifying the total responses into four groups. In the first group were students with a score less than or equal to the 25th percentile; in the second, those who were above the 25th percentile but below the 50th; in the third group, those who were above the 50th percentile but less than 75, and in the fourth group, the students who were above the 75th percentile (table 4). According to the results, 26.1% of the students lack entrepreneurial skills and 23.4% have very few. However, it should be noted that a quarter of the population has high potential for entrepreneurship.

Tabla 4. Distribución de frecuencias de las capacidades emprendedoras de los estudiantes de ingeniería y arquitectura

Capacidades emprendedoras	Percentil	Rango	%
Los estudiantes no presentan capacidad emprendedora.	25	0.72 -7.31	26.1
Los estudiantes presentan poca capacidad emprendedora.	50	7.32 - 8.31	23.4
Los estudiantes presentan capacidad emprendedora.	75	8.32 - 9.41	25.2
Los estudiantes presentan alta capacidad emprendedora.	100	9.42 - 12	25.3

Fuente: Elaboración propia

The global results of the measures of central tendency indicated that the scores are between “Neither agree nor disagree” (2) and “Agree” (3). No factor reached the value that indicated a strong agreement. The social factor reported the lowest mean and the highest standard deviation (Table 5).

Tabla 5. Descriptivos por factor y global de las capacidades emprendedoras

Descriptivos	Factor personal	Factor recursos	Factor social	Global
Media	2.72	2.88	2.67	2.75
Mediana	2.78	3.00	2.80	2.77
Moda	3.00	3.00	2.60	2.65
D.E.	0.64	0.68	0.76	0.55
N	343	343	343	343

Fuente: Elaboración propia

On the other hand, the analysis of variance (Anova) was carried out to identify significant differences for each factor of the entrepreneurial capacities between the educational programs (table 6).

Tabla 6. Comparación de las medias poblacionales de las capacidades emprendedoras por programa educativo

Factores	**Programa educativo**	**N**	**Media**	**F**	**Sig.**
Personal				1.774	0.134
	Mecánica Eléctrica	81	2.86		
	Civil	84	2.62		
	Eléctrica y Electrónica	30	2.67		
	Química	65	2.76		
	Arquitectura	83	2.67		
	Total	343	2.72		
Recursos				4.454	0.002*
	Mecánica Eléctrica	81	3.10		
	Civil	84	2.73		
	Eléctrica y Electrónica	30	3.09		
	Química	65	2.85		
	Arquitectura	83	2.79		
	Total	343	2.88		
Social				3.397	0.010*
	Mecánica Eléctrica	81	2.92		
	Civil	84	2.59		
	Eléctrica y Electrónica	30	2.75		
	Química	65	2.57		
	Arquitectura	83	2.56		
	Total	343	2.67		

Nota: *$p \leq 0.05$

Fuente: Elaboración propia

As can be seen in table 6, there are statistically significant differences between the educational programs with the Resources and Social factors. To know exactly between which programs these differences were found, the Bonferroni post hoc test was applied, which identified them between Mechanical Electrical Engineering and Civil Engineering (.004) and with Architecture (0.030) in the Resources factor. The result of the average indicates that Mechanical engineers perceive more capacity to start a business. In the Social factor,

differences were found between Mechanical Electrical Engineering with Civil Engineering (.048), with Chemical Engineering (.047) and with Architecture (.020); Here too, the Mechanical engineers registered a greater capacity for entrepreneurship.

Tabla 7. Comparación de las medias poblacionales de las capacidades emprendedoras por semestre

Factores	**Semestre**	**N**	**Media**	**D.E.**	**F**	**Sig.**
Personal					5.913	0.001*
	4.º y 5.º	95	2.51	0.66		
	6. º y 7.º	89	2.89	0.61		
	8.º y 9. º	99	2.72	0.64		
	10.º y 11.º	60	2.81	0.57		
	Total	343	2.72	0.64		
Recursos					1.032	0.379
	4.º y 5.º	95	2.81	0.70		
	6. º y 7.º	89	2.95	0.67		
	8.º y 9. º	99	2.85	0.74		
	10.º y 11.º	60	2.96	0.58		
	Total	343	2.88	0.68		
Social					3.237	0.022*
	4.º y 5.º	95	2.58	0.59		
	6. º y 7.º	89	2.86	0.78		
	8.º y 9. º	99	2.55	0.83		
	10.º y 11.º	60	2.72	0.82		
	Total	343	2.67	0.76		

Nota: *$p \leq 0.05$

Fuente: Elaboración propia

Table 7 shows that there are statistically significant differences between the entrepreneurial abilities of the students with the semester in the Personal and Social factors. The Bonferroni post hoc test showed in a timely manner that the differences were found in the Personal factor between students in the fourth and fifth semester with those in the sixth and seventh (0.001) and with those in the tenth and eleventh (0.029). Furthermore, according to the average

results, those in sixth and seventh grade have more entrepreneurial skills. In the Social factor, differences were identified between students in sixth and seventh with those in eighth and ninth (030). The average results show that sixth and seventh grade students tend to have greater entrepreneurial capacity. No statistically significant differences were found between entrepreneurial skills in relation to student grades.

Tabla 8. Comparación de las medias poblacionales de las capacidades emprendedoras por edad de los alumnos

Factor	**Edad**	**N**	**Media**	**D.E.**	**F**	**Sig.**
Personal					2.853	0.037*
	19 y 20	78	2.56	0.63		
	21 y 22	156	2.71	0.61		
	23 y 24	88	2.84	0.65		
	25 y 26	21	2.83	0.80		
	Total	343	2.72	0.64		
Recursos					2.686	0.047*
	19 y 20	78	2.82	0.74		
	21 y 22	156	2.81	0.70		
	23 y 24	88	3.06	0.59		
	25 y 26	21	2.90	0.63		
	Total	343	2.88	0.68		
Social					3.13	0.026*
	19 y 20	78	2.64	0.61		
	21 y 22	156	2.57	0.77		
	23 y 24	88	2.81	0.85		
	25 y 26	21	2.96	0.75		
	Total	343	2.67	0.76		

Nota: *$p \leq 0.05$

Fuente: Elaboración propia

In table 8, on the other hand, the Anova shows significant differences between entrepreneurial capacities with the age of the students. Subsequently, the Bonferroni post hoc test indicated that the specific differences were between students between 19 and 20 with

those of 23 and 24 years (0.032) in the Personal factor. In the Resources factor, the difference was found between those aged 21 and 22 with those aged 23 and 24 (0.046). This test did not show differences in the Social factor.

Tabla 9. Correlaciones entre los factores de emprendimiento con el promedio en las calificaciones, la edad y el semestre

Factores	**Personal**	**Recursos**	**Social**	**Promedio**	**Edad**	**Semestre**
Personal	1	0.548**	0.450**	0.036	0.149**	.128*
Recursos		1	0.408**	0.037	0.107*	0.055
Social			1	0.104	0.123*	0.010
Promedio				1	-0.130*	-0.093
Edad					1	0.600**
Semestre						1
** La correlación es significativa en el nivel 0.01 (dos colas).						
* La correlación es significativa en el nivel 0.05 (dos colas).						

Fuente: Elaboración propia

Pearson's correlation analysis showed very weak positive correlations between the three factors of entrepreneurial abilities with age. Regarding the semester they studied, a very weak positive correlation was identified only with the Personal factor; there were no correlations with the average in the grades (table 9).

Discussion

This research shows the entrepreneurial capacities through the factors called Personal, Resources and Social in the population of students enrolled in the Academic Division of Engineering and Architecture of a public university in the Mexican southeast. The results indicated that 26.1% of the students lack the skills to start a business and 23.4% perceive little faculty to do so, which reveals an area of opportunity to promote entrepreneurship activities in the study population. These results differ from those reported by Alvarado and Rivera (2011) and Cabana et al. (2013), who found that higher-level students are inclined towards activities related to entrepreneurship and show acceptable entrepreneurial abilities, which are the result of teaching directed towards this activity.

According to the Likert scale used in the research instrument, none of the factors indicated a value that determined the students with entrepreneurial abilities in a conclusive way. This result indicates that the entrepreneurial skills are not well formed in the students, especially in the Social factor, which reported the lowest mean, although greater variability was found in the responses in this factor.

In the comparison of the population means, the Bonferroni post hoc test reported a greater capacity for entrepreneurship in the Resources factor and in the Social factor in Mechanical engineering students; in the Resources factor with Civil Engineering and Architecture; in the Social factor with Civil Engineering, Chemical Engineering and Architecture. Faced with this information, it is worth reflecting on the point of view of Hatt (2018), who points out that, although higher education is an appropriate place to develop entrepreneurship, there is a lack of consensus on the best way to educate students. students with the aim of developing their entrepreneurial spirit.

Another finding of the study was the differences found in the Personal factor and in the Social factor with the semester, since the results of the means indicated that the sixth and seventh graders have greater capacities to start a business. Here an unforeseen floodgate opens: the possibility of a subsequent study to identify the causes of this result and generate proposals with a view to promoting entrepreneurship with greater interest in students who attend other semesters. An interesting piece of information was that students' grades do not influence their ability to start a business; Students with high scores would be expected to show a greater tendency toward entrepreneurship, but students were found to possess equal skills for creating businesses in terms of qualifications.

Regarding the age of the students, it was determined that those between 23 and 24 years old have a greater capacity for entrepreneurship in the Personal and Resources factors; However, in the Social factor, the capacity for entrepreneurship is similar despite the variability in age. Regarding gender, the data indicated equality of entrepreneurial capacities between men and women, which agrees with what was said by Alvarado and Rivera (2011), who also speak of a balance in this area.

In the analysis carried out to verify the existence of correlations, it was confirmed that, the higher the average in the grades, the older the age and the progress in the semesters, the entrepreneurial capacity does not increase because the correlations found were very weak.

Conclusions

Universities, being generators of knowledge, have in their hands the possibility of educating for entrepreneurship. Entrepreneurship entails the creation of jobs and, therefore, improves the living conditions of the population. The research presented here showed the results of the analysis of the entrepreneurial capacities in engineering and architecture students of a public university.

Thus, it allowed to determine that half of the student population does not present the capacity for entrepreneurship. Derived from the results, the need to design strategies that make it possible to enhance the entrepreneurial capacities in the study subjects is recognized, due to not being conclusively in the three factors analyzed. Likewise, specific alternatives are required for each of the educational programs since each one has its own characteristics.

The data obtained in the investigation come from an instrument elaborated with scientific rigor that can be applied in other similar contexts. This work opens the possibility of other qualitative studies to identify the causes of the results presented here; In this sense, considering that the lowest mean level of entrepreneurship in the Social factor was reported here, a line of research is suggested that allows discovering how the supports of family, teachers and friends for entrepreneurial initiatives of students are characterized. In the Personal factor, a line of research to explore is that of youth attitudes that can be channeled towards entrepreneurship.

References

Alvarado, O. y Rivera, W. F. (2011). Universidad y emprendimiento, aportes para la formación de profesionales emprendedores. *Cuadernos de Administración, 27*(45), 61-74. Recuperado de https://www.redalyc.org/pdf/2250/225019868005.pdf.

Berríos, J. E. (2017). Características emprendedoras: ¿Potenciales determinantes de la actividad emprendedora? *Revista Internacional de Administración & Finanzas, 10*(6), 1-15. Recuperado de http://www.theibfr2.com/RePEc/ibf/riafin/riaf-v10n6-2017/RIAF-V10N6-2017-1.pdf.

Cabana, R., Cortés, I., Plaza, D., Castillo, M. y Álvarez, A. (2013). Análisis de las capacidades emprendedoras potenciales y efectivas en alumnos de Centros de Educación Superior. *Journal of Technology Management & Innovation, 8*(1), 65-75. Recuperado de https://doi.org/10.4067/S0718-27242013000100007.

Cantillo, F., Piña O., Gómez, A. y Volpe, I. (2013). El efecto de la formación en emprendimiento sobre la construcción de una mentalidad emprendedora en estudiantes de Ingeniería Industrial en una universidad de la ciudad de Barranquilla. *Sotavento M.B.A.*, (21), 50-61. Recuperado de https://revistas.uexternado.edu.co/index.php/sotavento/article/view/3436.

Chen, S., Hsiao, H., Chang, J., Chou, C., Chen, C. and Shen, C. (2013). Can the entrepreneurship course improve the entrepreneurial intentions of students? *International Entrepreneurship and Management Journal*, *11*(3), 557–569. Retrieved from https://psycnet.apa.org/record/2015-33976-006-

Guerrero, M., Urbano, D., Ramos, A., Ruiz J., Neira, I. y Fernández, A. (2016). *Observatorio de Emprendimiento Universitario en España. Edición 2015-2016*. Madrid, España: Crue Universidades Españolas-RedEmprendia-CISE. Recuperado de https://www.crue.org/Documentos%20compartidos/Publicaciones/Observatorio%20de%20Emprendimiento%20Universitario/20161201_Observatorio%20de%20Emprendimiento%20Universitario_informe_web.pdf.

Gutiérrez, G. (2011). Educación emprendedora en la universidad: Educando para el futuro. *Retos, Revista de Ciencias de la Administración y Economía*, *2*(1), 49-68. Recuperado de https://www.redalyc.org/pdf/5045/Resumenes/Resumen_504550952004_1.pdf.

Hatt, L. (2018). Threshold concepts in entrepreneurship–the entrepreneurs' perspective. *Education + Training*, *60*(2), 155-167. Retrieved from doi.org/10.1108/ET-08-2017-0119.

Hidalgo, L. F. (2014). La cultura del emprendimiento y su formación. *Revista Alternativas, 15*(1), 46-50. Recuperado de http://editorial.ucsg.edu.ec/ojs-alternativas/index.php/alternativas-ucsg/article/view/8.

Núñez, L. y Núñez, M. (2016). Noción de emprendimiento para una formación escolar en competencia emprendedora. *Revista Latina de Comunicación Social*, (71), 1069-1089.

Osorio, F. y Pereira, F. (2011). Hacia un modelo de educación para el emprendimiento: una mirada desde la teoría social cognitiva. *Cuadernos de Administración, 24*(43), 13-33. Recuperado de http://www.redalyc.org/articulo.oa?id=20521435001.

Pérez, A. (2019). *Emprendimiento y creación de empresas: Análisis de las capacidades emprendedoras en estudiantes universitarios de las ciencias económicas y administrativas*. (tesis doctoral). Instituto Universitario Puebla, Villahermosa.

Rauch, A. and Hulsink. W. (2015). Putting Entrepreneurship Education Where the Intention to Act Lies: An Investigation into the Impact of Entrepreneurship Education on Entrepreneurial Behavior. *Academy of Management Learning & Education, 14*(2), 187-204.

Sanabria, P. E., Morales, M. E. y Ortiz, C. (2015). Interacción universidad y entorno: marco para el emprendimiento. *Educación y Educadores*, *18*(1), 111-134.

Sánchez, J., Caggiano, V. y Hernández, B. (2011). Competencias emprendedoras en la educación universitaria. *International Journal of Developmental and Educational Psychology*. *1*(3), 19-28. Recuperado de http://www.redalyc.org/pdf/3498/349832330001.pdf.

Soria, K., Zuniga S. y Ruiz, S. (2016). Educación e intención emprendedora en estudiantes universitarios: un caso de estudio. *Formación universitaria*, *9*(1), 25-34. Recuperado de https://scielo.conicyt.cl/pdf/formuniv/v9n1/art04.pdf.

Vera, P., Baquedano C., Ferrám, Y., Olavarría, S., Parra, E. y De Souza, B. (2008). Una innovación pedagógica para la formación de universitarios emprendedores. *Revista da FAE*, *11*(2), 113-126.

Rol de Contribución	Autor (es)
Conceptualización	María del Carmen Sandoval Caraveo (igual) Edith Georgina Surdez Pérez (igual) Abraham Gerardo Pérez Sandoval (igual)
Metodología	María del Carmen Sandoval Caraveo (igual) Edith Georgina Surdez Pérez (igual) Abraham Gerardo Pérez Sandoval (igual)
Software	No aplica
Validación	María del Carmen Sandoval Caraveo (igual) Edith Georgina Surdez Pérez (igual) Abraham Gerardo Pérez Sandoval (igual)
Análisis Formal	María del Carmen Sandoval Caraveo (que apoya) Edith Georgina Surdez Pérez (principal) Abraham Gerardo Pérez Sandoval (que apoya)
Investigación	María del Carmen Sandoval Caraveo (igual) Edith Georgina Surdez Pérez (igual) Abraham Gerardo Pérez Sandoval (igual)
Recursos	María del Carmen Sandoval Caraveo (igual) Edith Georgina Surdez Pérez (igual) Abraham Gerardo Pérez Sandoval (igual)
Curación de datos	María del Carmen Sandoval Caraveo (igual) Edith Georgina Surdez Pérez (igual) Abraham Gerardo Pérez Sandoval (igual)
Escritura - Preparación del borrador original	María del Carmen Sandoval Caraveo (igual) Edith Georgina Surdez Pérez (igual) Abraham Gerardo Pérez Sandoval (igual)
Escritura - Revisión y edición	María del Carmen Sandoval Caraveo (igual) Edith Georgina Surdez Pérez (igual) Abraham Gerardo Pérez Sandoval (igual)
Visualización	María del Carmen Sandoval Caraveo (igual) Edith Georgina Surdez Pérez (igual) Abraham Gerardo Pérez Sandoval (igual)
Supervisión	María del Carmen Sandoval Caraveo (principal) Edith Georgina Surdez Pérez (que apoya) Abraham Gerardo Pérez Sandoval (que apoya)
Administración de Proyectos	María del Carmen Sandoval Caraveo (principal) Edith Georgina Surdez Pérez (que apoya) Abraham Gerardo Pérez

	Sandoval (que apoya)
Adquisición de fondos	María del Carmen Sandoval Caraveo