PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE

ESCUELA DE INGENIERIA

# HOW AN ENTREPRENEURSHIP EDUCATION PROGRAM (EEP), PREDISPOSITION, AND GENDER AFFECT THE CHANGE IN ENTREPRENEURIAL SELF-EFFICACY (ESE) AND ENTREPRENEURIAL INTENTIONS (EI)

## MATÍAS FERNANDO FUENTES GELFENSTEIN

Thesis submitted to the Office of Research and Graduate Studies in partial fulfillment of the requirements for the Degree of Master of Science in Engineering

Advisors:

**MICHAEL LEATHERBEE GRANT**

**ALFONSO CRUZ NOVOA**

Santiago de Chile, June 2021

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To my family, friends and my supervising teachers who accompanied me in this process.

# THANKS

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# ABSTRACT

An increasingly important study field in entrepreneurship is entrepreneurship education and how Entrepreneurship Education Programs (EEP) affect the so-called antecedents of entrepreneurship behavior and how they interact between. We investigate whether or not the course 'Investigación, Innovación y Empredimiento', taught at the Pontificia Universidad Católica de Chile affects Entrepreneurial Self-Efficacy (ESE) and Entrepreneurial Intentions (EI) of students enrolled and how gender influences the results. Overall, this study found significant differences between the pre and post values of Entrepreneurial Self-Efficacy (ESE). The study found also that females have lower Entrepreneurial Self-Efficacy (ESE) at the beginning of the course, but that difference disappears at the end of the course. Also, females have lower intentions than males before and after the course. Another finding was that students who enter the entrepreneurship course with higher EI change their ESE between the beginning and end of the course to a greater extent than those who enter it with low intentions to undertake. These results can encourage the actual debate on the need for stronger entrepreneurship, innovative education, and female participation.

# RESUMEN

La educación en emprendimiento se ha vuelto un foco de estudio cada vez más importante de manera que, el impacto que generan los programas de educación en dicha área sobre los llamados antecedentes del comportamiento emprendedor y la interacción entre ellos ha tomado importancia como objeto de estudio en el último tiempo. Investigamos si el curso "Investigación, Innovación y Emprendimiento", que se imparte en la Pontificia Universidad Católica de Chile, afecta la Autoeficacia Emprendedora y la Intención de Emprender de los alumnos inscritos y cómo influye el género en los resultados. En general este estudio encontró diferencias significativas entre los valores pre y post de Autoeficacia Emprendedora. Otro hallazgo del estudio es que las mujeres tienen un menor nivel de Autoeficacia Empresarial que los hombres al principio del curso estudiado pero dicha diferencia desaparece una vez finalizado este. Así también, las mujeres tienen menor Intención de Emprender al principio y final del curso. Por último, se obtuvieron resultados que revelan que los estudiantes que ingresan al curso con un mayor nivel de Intención de Emprender cambian su Autoeficacia Emprendedora entre principio y final en mayor medida que los alumnos que ingresan al curso con un menor nivel de Intención de Emprender. Estos resultados aportan a fomentar el debate actual sobre la necesidad de un espíritu emprendedor más fuerte, una educación más innovadora y el refuerzo de la participación femenina en el ecosistema del emprendimiento.

## 1. INTRODUCTION

In the last decade, academia has put a strong emphasis on building theory about entrepreneurial education. The main question to answer has been how entrepreneurial education relates to real entrepreneurial ventures. This is important because on a premise: on which universities and educational institutions have based their curriculums is that entrepreneurial education is directly related to seeking entrepreneurial roles and tasks in the real world as a consequence of increasing related skills fundamental to beginning new business ventures. Literature states that different program characteristics lead to different results, with practical courses leading to different proportions of entrepreneurial self-efficacy (ESE) and nascency than theoretical-focused courses (Piperopoulos & Dimov, 2015).

Based on three psychological theories: Ajzen's Theory of Planned Behavior, Bandura's Self-Efficacy model and Shapero's Entrepreneurial Event model (Ajzen, 1996; Bandura, 1993; Shapero & Sokol, 1982), studies have shown how entrepreneurial behavior can be modified or incremented based on two variables: Entrepreneurial Self-Efficacy (ESE) and Entrepreneurial Intentions (EI). Since ESE is a crucial factor in entrepreneurship behavior, we must try to understand how it is built. Most entrepreneurship classes focus on enhancing ESE, however, the real impact of entrepreneurship courses on students' ESE has not been clearly defined (Shinnar et al., 2014). Due to this uncertainty, we seek to study the relationship between a practical entrepreneurship and innovation course and its influence in both ESE and EI on students before and after they attend it. We will also discuss how gender can influence these results and change in both ESE and EI. The present discussion is based mainly on two questions. First, we try to answer the question: Do university students who enter the course wanting to start up their own business (+EI), increase their ESE more than university students who do not want to start up their own business? Is this effect particularly stronger in women than in men? Second, are the university students with lower ESE when entering the course,

more likely to increase their intention to start up their own business (+EI)? Is this effect particularly stronger in women than in men? In this sense, the present study addresses the change in the ESE and EI variables from a longitudinal perspective, without the presence of self-selection bias, in addition to controlling the possible risks of ground and sky effects of longitudinal measurements. This article is structured in the following way: first, a scope of the existing and predominant theories on the subject in question is made. Then a review of previous studies is made with respect to our dependent and independent variables, later the methods and procedures for the work of the data are presented to finally present the main results, discussion, and recommendations for future studies.

## 2. THEORETICAL BACKGROUND

Entrepreneurship has been for years at the center of the economic growth debate. It is considered a key factor in sustainability, reducing the youth unemployment and skill gap, spreading innovation and putting people on a more central role in society. For many years, entrepreneurial education was considered as something difficult to conform to the classical dogmas of pedagogy (Aronsson, 2004). General education tended to discourage entrepreneurial intentions and behavior. At the post-secondary level, schools and universities prefer to focus on preparing students to be good employees for organizations as their only career choice (Rideout & Gray, 2013). Even business schools, according to an interview of David Birch in 2004 by Magnus Aronsson, do not teach the three skills that an entrepreneur needs to know and master: selling, managing people, and creating a new product or service (Aronsson, 2004).

To build a theory and foundation of entrepreneurship education various researchers have conducted several different investigations to understand if education can have an important role in a possible entrepreneurship career path (Abaho et al., 2015; Gielnik et al., 2015; Li & Wu, 2019; Shinnar et al., 2014; Souitaris et al., 2007). Most of these studies have been based on one or more of three psychological theories that can be applied to entrepreneurship education: Ajzen's Theory of Planned Behavior (TPB),

Bandura's Self-Efficacy, and Shapero's Entrepreneurial event. (Ajzen, The theory of planned behavior, 2012) (Bandura, Perceived Self-Efficacy in Cognitive Development and Functioning, 1993) (Shapero & Sokol, 1982) Ajzen's theory says that behavior with different intentions to perform can be predicted with high accuracy from attitudes towards that behavior, subjective norms, and perceived behavioral control. These intentions, together with perceptions of behavioral control account for considerable variance in actual behavior. Attitudes, subjective norms, and perceived behavioral control are related to appropriate sets of salient behavioral, normative, and control beliefs about that behavior, but the exact nature of these relationships is still uncertain. Expected-value formulations are found to be only partly successful in dealing with these relations. Intentions have been defined in the TPB as "behavioral plans that [...] enable attainment of a behavioral goal" (Ajzen, 1996), or simply "proximal goals" (Bandura, 1997).The theoretical definitions for the other independent variables (attitude, subjective norm, and perceived behavioral control) are that attitude is defined as the degree to which a person perceives the behavior based on a favorable or unfavorable assessment of that conduct (Ajzen, 1991, 1996). Subjective norm is any social influence that may determine if the individual performs or does not perform the behavior (Ajzen, 1991; Ajzen et al., 2004). Perceived behavioral control is the level of confidence an individual has about their ability to perform the behavior based on how easy or difficult they perceive its performance as it relates to hindrances or facilitators (Ajzen, 1991; Ajzen et al., 2004). According to Ajzen and Fishbein (2004), the three precedents mentioned are sufficient to explain the intentions, but their relative importance varies from one context to another (i.e., in some contexts, only one or two of the described variables may be necessary to explain the intentions). A graphical explanation of the Ajzen Theory of Planned Behavior is given by the Figure 1 (Ajzen & Fishbein, 2004).

The definition of Ajzen's antecedent of intentions-perceived behavioral control came directly from the definition of self-efficacy given by Bandura. Bandura supports that perceived self-efficacy contributes to cognitive progress and functioning in several ways. It can be defined as the belief in one's capabilities to codify and execute the courses of

action required to manage positive situations. Perceived self-efficacy exercises its influence through four principal areas. They include cognitive, motivational, affective, and selection processes. Bandura states that there are three different levels at which perceived self-efficacy operates as an important contributor to academic development: students' beliefs in their efficacy to regulate their learning and to master academic activities determining their aspirations, level of motivation, and academic accomplishments. Teachers' beliefs in their efficacy to motivate and promote learning affects the types of learning environments they create and the level of academic progress their students achieve. The faculty's belief in their collective instructional efficacy contributes significantly to their schools' level of academic achievement (Bandura, 1993). According to this theory, if entrepreneurship education instructional delivery imparts the four processes and enhances students' entrepreneurship outcome expectations, entrepreneurial self-efficacy can theoretically be improved, leading to entrepreneurial behavior. The model below explains how ESE is affected by the four factors explained in Figure 2. (Bandura, 1997).

On Shapero's Entrepreneurial event model, EI comes from the perceived desirability and feasibility of becoming an entrepreneur, and it is determined by one's attitude toward the behavior, perceived social norms and perceived behavioral control (Shapero & Sokol, 1982). The variables can be explained as follows:

1)    *Perceived Desirability (PD)* is the product of an individual's perceptions of desirability of entrepreneurship related to personal attitudes, values, and feelings.

2)    *Perceived Feasibility (PF)* is related to an individual's perception of available resources. In other words, it measures the individual's personal perceived ability to carry out certain tasks.

3)    *The Propensity to Act (PTA)* is the personal disposition to act on one's decisions, reflecting volitional aspects of intention.

This model and Ajzen's are quite compatible and overlapping, with direct congruity between perceived feasibility and perceived behavioral control. Personal attitude and perceived social norms are also social and cultural influences of perceived desirability (Guerrero et al., 2008; Krueger, 2007; Liñán et al., 2011). A graphical model of Shapero's Entrepreneurial event model is given by the Figure 3 (Shapero & Sokol, 1982).

From these starting psychological models, many researchers tried to apply them to EE through empirical studies that show how EI is correlated to independent variables, leading to different conclusions (Fayolle & Gailly, 2015; Li & Wu, 2019; Sánchez, 2013; Souitaris et al., 2007). Souitaris, Zerbinati, and Al-Laham, (2004) based on the planned behavior theory, showed that the analyzed entrepreneurial programs taught in London, England and Grenoble, France, increased the subjective norms and intentions toward self-employment. However, intentions at the end of the programs were not related to nascency, intended as the process of start-ups on the creation of an organization (Souitaris et al., 2007). This can be attributed to the time-lag between entrepreneurial intention and behavior, especially concerning undergraduates.

Complementary studies, enrich the information about the effectiveness of entrepreneurship education programs considering different variables and hypotheses from the basic model of Ajzen. A relevant example of this is given by Entrialgo and Iglesias (2016), which analyzes how the interaction between entrepreneurial education program and subjective norms shapes the perceptions and attitudes toward entrepreneurship, leading to results that have relevant implications for women's entrepreneurship. They enriched the model with the presence of gender as an independent variable, concluding that subjective norms coming from a close social environment carry greater weight with women than with men concerning entrepreneurship (Entrialgo & Iglesias, 2016).

Piperopoulos and Dimov analyzed the effect of ESE on EI, depending on two different types of entrepreneurship courses: "theoretically oriented", and "practically

oriented". They found that the nature of the course moderates the relationship between students' ESE, beliefs and EI, such that the relationship is negative in "theoretically oriented" courses and positive in "practically oriented" courses (Piperopoulos & Dimov, 2015). On this line, Graevenitz, Harhoff, and Weber (2010) analyzed the effects of EEP Group of students who had no intention of learn about entrepreneurship but who necessarily had to take a course. They found that students update their beliefs about their entrepreneurial aptitude during the courses. In particular, initially undecided students are most likely to change their beliefs most readily. For all these studies, pre-test and post-test statistics were used to discuss the hypotheses formed, and in this way, von Graevenitz, Harhoff, and Weber (2010) proposed a relevant modification. Their model based on the idea that an entrepreneurial education program generates signals to students is tested using data from a compulsory entrepreneurship course taught in Germany. Students were surveyed (either using a written or online survey) directly before the kickoff session of the course and immediately before the time when the students received their grades at the end of the semester (Graevenitz et al., 2010). The fact that the course was compulsory and that the responses reached 97.8% of total enrollment eliminated self-selection bias. Self-selection bias is the problem that very often results when survey respondents are allowed to decide entirely for themselves if they want to participate in a survey, or if they can decide to enroll or not in the course. To the extent that respondents' propensity for participating in the study is correlated with the substantive topic the researchers are trying to study, there will be self-selection bias in the resulting data. In most instances, self-selection will lead to biased data, as the respondents who choose to participate will not well represent the entire target population (Lavrakas, 2008).

The difference between compulsory and elective courses that can give selection bias influencing the results was deepened by Karimi et al. (2016) and by Oosterbeek et al. (2010). Karimi et al. (2016) worked on a sample considering 205 students divided into two groups: elective and compulsory entrepreneurship education program. The study showed that elective entrepreneurship education program significantly increased students EI, although this increase was not significant for the compulsory program (Karimi et al.,

2016). It also indicated that when comparing elective and compulsory entrepreneurship education programs, EI change is not equally distributed across these programs. This makes it a relevant factor for the study of the effect of EEPs, which was confirmed by the study of Oosterbeek et al (2010), based on the impact of EEPs in a compulsory course using a difference-in-difference technique. They instrumented the location choice and the treatment, to conclude that the effect on students' self-assessed entrepreneurial skills is insignificant. Moreover, the effect of the course on EI is significantly negative.

This gave space to studies that assess whether different teaching methods and learning environments would have different effects on the outcomes. Fayolle and Gailly (2015) avoided selection bias and analyzed a compulsory program taught in France. They studied a 'compact' program rather than programs combining multiple teaching components whose effects cannot be disentangled. They studied not only the immediate effects of EEP on intentions but also the medium-term effects thanks to a survey done six months after the end of the program, giving space to results that compare short-term results of all previous literature with medium-term results. They found no impact on EI six months after the end of the EEP. This is attributed to two possible factors: First of all, during the semester that students enroll in management courses, they have not been confronted with teachings in entrepreneurship. Second, within the context of a French School of Management, proposed internships and visiting companies all belong to the world of large firms (Fayolle & Gailly, 2015).

This paper aims to develop these authors literature on the effects that entrepreneurship education programs have on EI, basing our model on ESE as a precedent for these intentions. The three relevant factors that are not strongly taken into consideration by the literature that will be studied are gender, already discussed by Entrialgo and Iglesias (2016), avoiding selection-bias, and, as recommended by Entrialgo & Iglesias, including a longitudinal analysis of the variables through a large sample (Entrialgo & Iglesias, 2016; Newman et al., 2019). In this way, we will proceed to review

the literature regarding the relationship of both Education and Entrepreneurial Self Efficacy (ESE); ESE, EI and Gender and EI as an outcome of ESE.

## 2.1 Education and Entrepreneurial Self Efficacy (ESE)

Literature shows that both training and education programs enhance ESE. Following Social-Cognitive theory, entrepreneurial education would expose students to crucial experiences and content for improving ESE.

Most studies have been based on how entrepreneurial education can have a positive impact on ESE. Several authors have implicitly or explicitly suggested that there is a link between entrepreneurship education and ESE (Newman et al., 2019). Theoretically, EEPs should help students develop the skills and competencies necessary to pursue entrepreneurial ventures. As a consequence, an EEP should increase students' confidence when creating and evaluating entrepreneurial opportunities, as well as their ability to secure the necessary resources to materialize them (Shinnar et al., 2014). For their part, Nowinski et al. (2019), in their study on the influence of education programs in EI and ESE in the countries of the Visegrad, discovered with statistical significance that education programs would have a positive influence regarding the development and increase of ESE. Even so, such results would be even stronger for women who in principle would have lower ESE than men, so they would be more benefited than men in terms of increasing ESE (Nowiński et al., 2019). Gielnik et al. (2017), through a short and long-term longitudinal study on the influence of entrepreneurship training, mainly discovered that entrepreneurship training would tend to increase passion and that such passion would be maintained at a high level by entrepreneurship. presence of high levels of ESE, Additionally, they discover that ESE would also be positively affected by the creation of an enterprise, in this way practical entrepreneurship training would tend to increase levels of ESE (Gielnik et al., 2017). Another study of Karlsson et al. (2013) carried out an exploratory study in which the treatment group received an entrepreneurship program to see the changes before and after carrying out such a program. The main significant results

were that the treatment group versus the control group showed higher levels of ESE, more entrepreneurial attitudes and a more entrepreneurial behavior after finishing the course (Karlsson & Moberg, 2013). To continue the discussion based on the link between *Education and Entrepreneurial Self Efficacy (ESE)*, the following hypotheses are proposed:

*H1: Students at the end of the practical entrepreneurship education course will have more ESE than at the beginning of the course, both males and females.*

## 2.2      ESE, EI and Gender

Elam et al. (2019) based on the Women's Entrepreneurship report by the Global Entrepreneurship Monitor (GEM 2019) found differences in average female Total Early-stage Entrepreneurial Activity (TEA) rates depending on the economic growth of the country. In factor-driven economies, 7.2 females were engaged in early-stage entrepreneurship for every 10 males. Europe and North America report the lowest female involvement in early-stage entrepreneurial activity, as well as the lowest gender parity. Because of, gender stereotyping, subjective norms and cultural expectations, females display less levels in different variables of entrepreneurship measurement than males. As an example, research shows that in general women do not have the same extent of business connections that men have. Researchers from GEM (2019) have also shown that women are less likely than men to know an entrepreneur. In this way, women are disadvantaged from the start by having fewer role models, which could affect their Entrepreneurial Perceived Behavioral Control (Elam et al., 2019). Gender stereotyping has context-depending effects, and even though there are societies in which feminine traits can be seen as adequate for some type of entrepreneurship (Gupta et al., 2019), in many western societies' entrepreneurship is still a stereotypically masculine career (Théabud, 2010).

According to research, gender plays an important role in mediating the relationship between education, entrepreneurship, ESE and EI. Dempsey and Jennings (2014), carried

out a study to show the possible differences between men and women in terms of ESE. The main findings were that indeed women would have lower ESE than men, but they also showed that such differences would be given in part due to the lower exposure of women to previous experiences in entrepreneurship, more possibility of receiving worse feedback and lower level of affection to entrepreneurship itself (Dempsey & Jennings, 2014). For his part, Diaz-García and Jiménez-Moreno (2010) in their study on the role of gender in EI, mainly shows that men would have more thoughts about creating their own firm, rather than being determined to do so. Of those men who would have more thoughts about creating own firm, the ones who consider entrepreneurship to be somewhat more masculine would be more likely to actually create their own firm. Under the same logic, Wilson et al. (2009), from a study applied in different stages of education and career showed that women would benefit more than men in terms of strengthening their ESE after receiving entrepreneurship education. This applies to middle school, high school, MBA students and early career adults (Wilson et al., 2009). To add us in the discussion based on the of *ESE, EI and*, the following hypotheses are proposed:

*H2a: Females will have a lower level of ESE than males both at the beginning and at the end of the practical entrepreneurship education course.*

*H2b: Females will have a lower level of EI than males both at the beginning and at the end of the practical entrepreneurship education course.*

## 2.3      EI as an outcome of ESE

Most scholars have used Ajzen's model as a reference to state that an increase in ESE will result in higher EI. Perceived Behavioral Control refers to an individual's belief and confidence in his / her capability in performing as an entrepreneur and realizing control and success in entrepreneurial activity (Ajzen, 1991). If a person holds strong control beliefs about the existence of factors that will facilitate a behavior, then the individual will have high perceived control over a behavior. Conversely, the person will

have a low perception of control if she holds strong control beliefs that impede the behavior. This perception can reflect past experiences, the anticipation of upcoming circumstances, and the attitudes of the influential norms that surround the individual (McKenzie et al., 2009). For his part, Bagheri and Lope Pihie (2014) examines in his study the relationship between attitudes about entrepreneurship, ESE, subjective norms and the social appreciation of entrepreneurship. His results show that it would be evident that ESE would benefit intentions to a greater extent in men while in women the effect of subjective norms on the intention to undertake would be strong (Bagheri & Lope Pihie, 2014). In this sense Austin and Nauta (2016), conducted a study in women on exposure to role models and among their findings is the presence of a clear link between ESE and EI as the exposure to role models in entrepreneurship would mediate such a relationship (Austin & Nauta, 2016). To summarize, the research of many scholars supports that the intention to become self-employed is positively and significantly correlated to ESE (Engle et al., 2010; KruegerJR et al., 2000; Pihie & Bagheri, 2011; Souitaris et al., 2007)  and that entrepreneurial programs raise the Perceived Behavioral Control of students (Rauch & Hulsink, 2015). To continue contributing to the discussion based on the link between ESE and EI, including the factor of change in the short term influenced by a practical entrepreneurship course and predispositions, the following hypotheses are proposed:

*H3a: Students who enter the practical entrepreneurship education course with a higher ESE level will increase their EI to a greater extent than those students who enter the course with lower ESE. This increment will be stronger for females than for males.*

*H3b: Students who enter the practical entrepreneurship education course with a higher EI level will increase their ESE to a greater extent than those students who enter the course with lower EI level. This increment will be stronger for females than for males.*

## 3. RESEARCH SETTINGS AND METHODS

### 3.1 Participants and Procedures

The course 'Investigación, Innovación y Emprendimiento' gives the student the basic knowledge of technology base entrepreneurship and innovation. During the course, the students are exposed to state-of-the-art techniques and strategies related to the discovery of innovation opportunities, design and implementation of entrepreneurship opportunities. To develop these skills, students work collaboratively in teams of five students on real products or services prototypes innovations. The process consists of four main steps, at the end of which the group presents their progress to the professor and investors, receiving a mark. Step one is about the problem description and development. At the beginning of the course professors give the students a general topic, to which students have to find three problems and describe them from a user's point of view, collecting experiences and feedback from people affected by the problem, and pointing out which is the real necessity to satisfy. With an identified problem, the group will develop the first prototype of a product or service to solve a necessity related to the problem. In this step the university provides support with designers and entrepreneurs, in addition to laboratories and tools useful to develop the prototype. The third step is to build a second version of the prototype and add a business model to the project. In this step, support and feedback are given by Chilean and international investors. The fourth and last step is to improve the prototype, then finally present it, by the with an effective presentation and a speech. The final project is then presented to the board, and the best projects (almost 20 per year) are selected to go to the semifinals. Same process is done on the semifinals, where the best presentations are selected to go to the finals, done with the presence of the board of investors, all the professors and all the students who participated in the course. The three winners of every semester will receive a money prize, and some facilitation to begin a start-up based on the project developed during the semester. This

course was initially designed in 2015, together with the Sutardja Center for Entrepreneurship and Technology (SCET) of the University of Berkeley.

We conducted the study with data received from the 8 semesters in which the course ING2030 was taught (2015-2018). The course is taught compulsory to all the students of the 3$^{rd}$ year of Engineering. We selected as participants to the study the whole sample of students enrolled in the course, with the aim to eliminate self-selection bias. It is also important to underline that the course is one of the first to be studied by the literature in South America. This study can help, together with the ones already present in the literature, to increase the generalizability of the results by adding a sample of more than a thousand students, without selection bias and through a longitudinal study.

We adopted pre-tests and post-tests to measure the initial and final level of the variables, and the change in them over a period of approximately 5 months. For our study we will not use a control group since there is not a course with similar characteristics and that is elective on the same university. It was clearly explained to the surveyed students that the questionnaires were for research and didactic purposes only, participation was mandatory for self-selection bias avoiding, and their views would not affect their grades. Both time 1 (t1) and time 2 (t2) questionnaires were reviewed by the department of Industrial Engineering to ensure clarity of wording and face validity of the results.

### 3.2 Measures

The questions were based on a quantitative instrument to assess the effects of a core-engineering course based on technology-based entrepreneurship on students' self-efficacy and entrepreneurial intent. This instrument derived from an unpublished questionnaire used in Cooper & Lucas, (2006) it was piloted on paper during the first semester of 2015, and it was applied online at the beginning and at the end of the second semester of 2015, the first semester of 2016, 2017 and 2018 and the second semester of 2016, 2017 and 2018 (Cooper & Lucas, 2006). From the 1400 effective responses, the

response rate at t1 was 63.5% and at t2 was 59.6%, the matched response rate of t1 and t2 was 58.5%. Of the matched responses, 25.1% were females and 75.9% males.

### *Dependent Variables*

Entrepreneurship Intention, as our dependent variable, was measured with a 5-point Likert Scale for the 2015 normalized to 10, and a 7-point scale, normalized to 10, for the 2016, 2017 and 2018 classes from 'I completely disagree', to 'I totally agree' based on four questions. The questions were: (1) If I had the opportunity to work on a start-up in the coming years, I would take it, (2) I am attracted to the idea of a high-risk project with high return of investment, (3) I often think on ideas and ways to start an entrepreneurship, and (4) I would like to live the entrepreneurial experience at least once.

### *Independent Variables*

Entrepreneur Self-efficacy or Perceived Behavioral Control was measured with a Likert scale based on the answers to 9 sub questions in which the students had to choose between 1 (completely ineffective) to 10 (completely effective). The questions were: (1) Design a prototype to understand how a new product or service works, (2) Solve a problem whose statement does not contain all the necessary information, (3) Describe clearly a problem orally, (4) Describe clearly a problem in a written way, (5) Ask questions that encourage others to think and explore ideas, (6) Motivate a group of people to work as a team, (7) Recognize a good opportunity to generate a product or service with international projection, (8) Study a technology and discover a new way of use that is practical and (9) begin a technology-oriented venture. Gender is a dummy variable (female = 0, male =1).

### *Control Variables*

To avoid any type of bias related to the student's performance in previous semesters, the GPA variable (1 to 7) is included, and in the same way the professor with whom the student took the course is included.

*Ordinary Least Squares (OLS) models and Ceiling and Floor effect control*

To address the hypotheses about the predisposition of students when entering the course in terms of ESE and EI and their influence in the change between the beginning and the end of the course of these variables, two controlled OLS models are proposed to avoid Ceiling and Floor bias. Control by semester of the course and by teacher is included. The proposed models are presented below:

<u>*Model OLS 1*</u>: $\Delta ESE = \alpha + \beta_1 EI(t1) + \beta_2 Male + \beta_3 GPA + \beta_4 Semester + \beta_5 Professor + \epsilon$

<u>*Model OLS 2*</u>: $\Delta EI = \alpha + \beta_1 ESE(t1) + \beta_2 Male + \beta_3 GPA + \beta_4 Semester + \beta_5 Professor + \epsilon$

As this is a longitudinal study with variables measured on a Likert scale with a beginning and a limit, there is a risk of a Ceiling and Floor effect. Such effect occurs when the scores of the participants accumulate in the lowest or the higher ends of the scale. This problem causes us to miss changes in the subjects of the extremes since they have no more possibility of going up if they are at the top of the score, or going down if they are at the bottom (Garin, 2014). To control the possible ceiling and floor effect, the following applies: a full regression model is applied, then the same regression model is applied eliminating the highest and lowest quantiles of the data. With the above, a ceiling or floor effect exists if there is a difference between the complete model versus the model controlled by quantiles about the significance and sign of coefficients.

## 4. RESULTS

This study used t-test to prove difference of means t and Ordinary Least Squares (OLS) regressions models to test the proposed hypotheses about change. All the proposed hypotheses were tested and validated by different controls to avoid Floor and Ceiling Bias.

Table 1 shows the descriptive results of the different variables of interest and control, as well as the level of correlation.

From Table 1, we can see that both ESE and EI at the aggregate level increase between the beginning and the end of the course. On one hand, ESE increases by 0.41 points on the scale while the EI increases by 0.24 points. On the other hand, when analyzing the correlation matrix between the variables; included in this study, it can be seen that there is not a high level of correlation between variables, only in those longitudinal ones that correspond to the same measurement in different periods of time. In this way, we can ensure that we would not be facing correlation problems between variables for the regression models.

Tables 2 and 3 show the results of the difference of means t-tests to analyze the proposed hypotheses corresponding to H2a and H2b.

From the analysis of Tables 2 and 3 it is possible to show different assertions that have been discussed in the literature, first and at an aggregate level we can note that students who take the practical entrepreneurship program studied here increase their ESE level by one score from 6,309 to 6,717, said increase is statistically significant (p <0.05), so it is evident that a practical entrepreneurship course would increase ESE as the literature has raised (Byabashaija & Katono, 2011; Gielnik et al., 2017; Karlsson & Moberg, 2013; Kubberød & Pettersen, 2017; Nowiński et al., 2019). Continuing with the above, when disaggregating by gender such statistical difference is maintained, in this way there is support to accept hypothesis H1 which states that students would have a higher level of ESE at the end of a practical entrepreneurship course.

Now, with regard to the analysis between gender, and according to previous studies (Dempsey & Jennings, 2014; Díaz-García & Jiménez-Moreno, 2010; Wilson et al., 2009) indeed men would have a higher level of ESE at the beginning of the practical entrepreneurship course (6,348 vs. 6,196) with statistical significance (p<0.1). This

difference at the beginning disappears when the measurement is made when the course has already finished (6.71 v/s 6.738), that is, men have a higher initial ESE but after a practical entrepreneurship course ESE between men and women is leveled. In this way, the H2a hypothesis is partially fulfilled since it states that men would have a higher level of ESE both at the beginning and at the end of the course, which occurs only at the beginning. This is an interesting finding since previous studies have not been able to demonstrate such behavior of ESE between the beginning and end of a course when comparing by gender. With respect to EI, what is stated in previous studies is fulfilled (Nowiński et al., 2019) men would have higher EI than women, for the case of this study there was a statistically significant difference both for the beginning of the course ($p<0.05$) and at the end of the course ($p<0.05$). Therefore, the H2b hypothesis is fulfilled in that at any point in time men have a higher EI score than women.

Tables 4 and 5 show the results of the OLS regressions with the different quantile cuts to avoid Floor and Ceiling biases. The regressions presented are the basis for analyzing hypotheses H3a and H3b.

Based on Table 4, we can note that we are in the presence of Floor and Ceiling bias. The above is explained since the coefficient $\beta = -0.0956$ relative to the independent variable ESE (t1) of model 1 is statistically significant ($p < 0.05$), but when observing models 2, 3 and 4 such significance is lost, so the extremes of the ESE variable (t1) would be biasing the results of the regression. Now, if we then look at models 2, 3 and 4, we can see that since there is no significance ($p > 0.05$), the hypothesis that students who enter the course with a higher level of ESE would increase their EI level more once the course is finished than those who enter the course with a lower ESE. Thus, there is no evidence to support the H3a hypothesis. Regarding the gender variable, we can show that for all our models the coefficients are significant ($p < 0.01$), so that men would have a greater change in EI than women ($\beta = 0.356$). Finally, regarding the GPA control variable, statistical significance is not obtained for any model ($p > 0.05$) so that it is not possible to ensure that

the student's GPA influences the change in EI between the beginning and the end of the course.

With respect to table 5 and the hypothesis that proposes that students who enter the course with a higher level of EI would tend to increase their ESE to a greater extent between the beginning and end of the course than those students who enter the course with a lower level of EI, it is possible to notice that again we would be facing a Floor and Ceiling effect. The above is possible to demonstrate when comparing model 1 and the negative coefficient ($\beta$ = -0.0812) of the variable EI (t1) with the coefficients of the same variable in models 2, 3 and 4. We can notice that for the latter the signs are positive, therefore, by removing the highest and lowest extremes of the variable EI (t1) our coefficients become positive. In this way, we look at models 2, 3 and 4 to analyze hypothesis H3b. It is evident that with statistical significance ($p<0.01$) an increase in the variable EI (t1) will mean an increase in the change of ESE between the beginning and end of the course. In this sense and based on model 4 which excludes the highest and lowest extremes in a more tight way, and therefore represents a greater part of the sample, for each increase in the level of EI (t1) the change in ESE between the beginning and end of the course, increases by 0.0944. Said increase is statistically significant ($p<0.01$). Thus, hypothesis H3b, which holds that students who enter with a higher EI will have a greater change in their ESE between the beginning and end of the course, is sustained and supported for at least two thirds of the sample. Finally, with respect to our control variables, there is no statistical significance to show that men would have a greater change in their ESE between the beginning and end of the course than women. The same occurs with GPA, as there is no statistical significance to suggest that it would influence the change in individual's ESE.

## 5. DISCUSSION

From the findings that it was possible to rescue from the data obtained in this study and its subsequent analysis, it is possible to notice the remarkable persistence of gender differences that occur in the world of entrepreneurship and education. Even so, the present study managed to identify something that would have important implications in terms of the valorization and structuring of entrepreneurship programs. Thanks to the analysis of the data, it was possible to show that the differences in terms of ESE between genders disappear once the course is finished. This it is tremendously important in terms of educational effectiveness to eliminate existing gender gaps in the field of innovation and entrepreneurship. In this sense, for the hypotheses H1 as mentioned in the results and in view of the previously carried out analyzes (Byabashaija & Katono, 2011; Gielnik et al., 2017; Karlsson & Moberg, 2013; Kubberød & Pettersen, 2017; Nowiński et al., 2019), it would be more than proven that the EEP in part increases the ESE of both men and women.

Regarding the aforementioned, it is no less important that despite the fact that students without controlling for gender increase their ESE after completing the EEP, men still have a significantly higher level at the beginning of the course that is moderately level at the end of said course (Dempsey & Jennings, 2014; Díaz-García & Jiménez-Moreno, 2010; Wilson et al., 2009). It is not so in the case of EI where women have a significantly lower level of EI at the beginning and even more so at the end of the course, this is interesting in the sense that there could be a gender factor associated with the case of having the intention to be an entrepreneur in the future that still at least is not entirely clear (Nowiński et al., 2019).

On the other hand, the findings that are related to the change in ESE between the beginning and the end of the course and how the predisposition regarding the intention to start an enterprise (EI) open an interesting discussion regarding the cross-sectional level of analyzing data. EI is formed as an outcome of the ESE level, but, if we focus on the

predisposition that students have when entering the course in terms of their EI level, we can notice a significant influence because students who enter with greater intention to start a business increase their ESE to a greater extent by going through a practical entrepreneurship course than those who enter with less intention of starting a business. In this way, the possibility of studying the dependence of the ESE variable but at the level of change over time influenced by the EI is opened. However, this result its very nascency and new but no less important because the importance of pre enforce the intention and self-efficacy of the alumni in previous practical courses.

These findings provide the basis for continuing to improve and structure innovation and entrepreneurship courses and contribute to policy makers to support entrepreneurship education policies focused on what really increases the possibility of having more entrepreneurship as well as greater participation of women in the field.

## 5.1    Limitations and future research

Given that the response rate for ESE and EI measurements was about 58%, the results don't allow us to generalize for the entire population but do give us important insight into the effects of entrepreneurial education. This study is based on data from engineering students from a specific university, so we cannot extrapolate these results to the general population of people taking entrepreneurship courses. In this sense and as a recommendation for future studies on the subject, it would be interesting to be able to apply an instrument to measure the ESE and longitudinal EI at the regional level in different institutions in order to be able to compare the effects of entrepreneurship courses and programs at an aggregate level to control for sociodemographic characteristics such as socioeconomic level, years of accreditation of the educational institution, etc.

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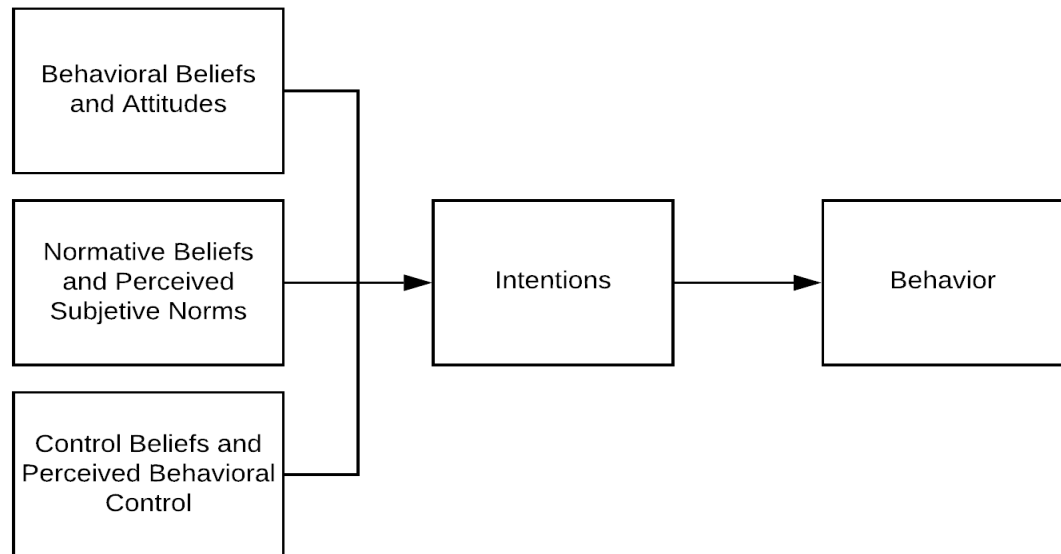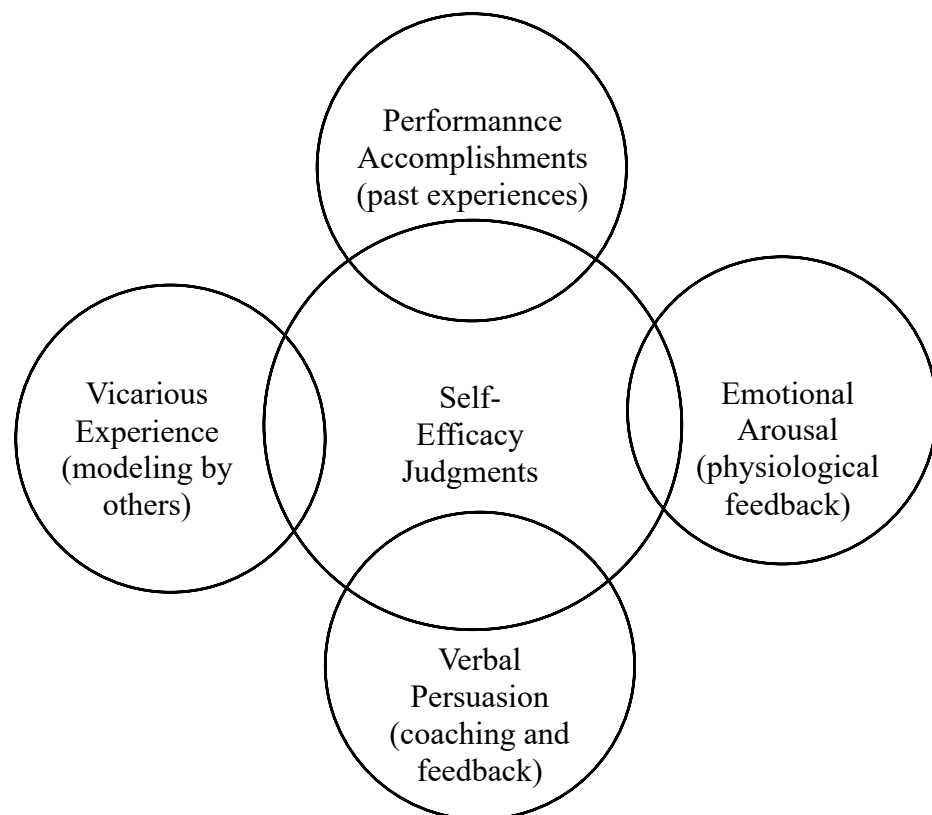
**ATTACHMENTS**

**Figure 1**: Theory of Planned Behavior Model



**Figure 2**: Bandura's Self-Efficacy Model

**Figure 3**: Shapero's Entrepreneurial Event Model
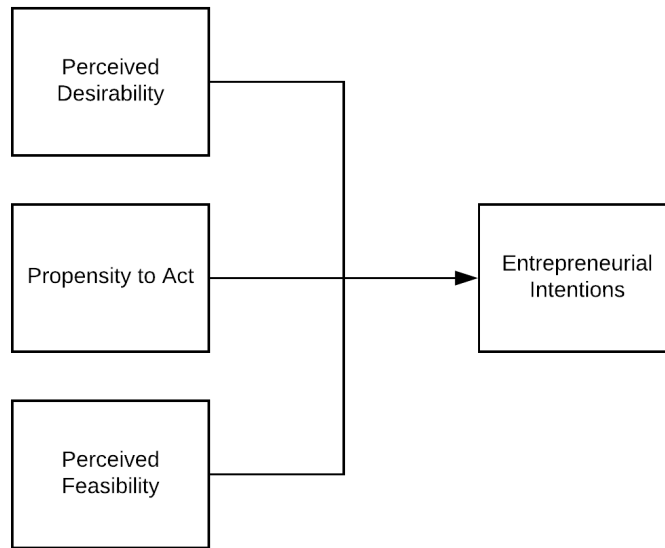


**Table 1:** Mean, SD, min, max and Matrix of Correlations

|  | Mean | Standard Deviation | Min | Max | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|---|---|---|---|
| (1) ESE(t1) | 6.31 | 1.46 | 1.00 | 10.00 |  |  |  |  |  |
| (2) EI(t1) | 6.33 | 1.87 | 1.00 | 10.00 | 0.36 |  |  |  |  |
| (3) ESE(t2) | 6.72 | 1.62 | 1.12 | 10.00 | 0.37 | 0.21 |  |  |  |
| (4) EI(t2) | 6.57 | 2.26 | 1.00 | 10.00 | 0.25 | 0.57 | 0.36 |  |  |
| (5) Gender | 0.75 | 0.43 | 0.00 | 1.00 | 0.04 | 0.07 | -0.01 | 0.12 |  |

**Table 2:** Paired t-test mean differences in ESE(t1) y ESE(t2) by Gender

|  | obs | ESE(t1) | ESE(t2) | dif | St_Err | t_value | p_value |
|---|---|---|---|---|---|---|---|
| All Students | 1,400 | 6.309 | 6.717 | -.408 | .046 | -8.8 | 0*** |
| Female Students | 352 | 6.196 | 6.738 | -.543 | .095 | -5.7 | 0*** |
| Male Students | 1,048 | 6.348 | 6.71 | -.363 | .053 | -6.85 | 0*** |

**Tabla 3:** Two-sample t-test, differences between gender

|  | obsF | obsM | Females | Males | dif | St_Err | t_value | p_value |
|---|---|---|---|---|---|---|---|---|
| ESE(t1) | 352 | 1,048 | 6.196 | 6.348 | -.152 | .09 | -1.7 | .091* |
| EI(t1) | 352 | 1,048 | 6.102 | 6.404 | -.302 | .115 | -2.65 | .009*** |
| ESE(t2) | 352 | 1,048 | 6.738 | 6.71 | .028 | .1 | .3 | .779 |
| EI(t2) | 352 | 1,048 | 6.068 | 6.733 | -.665 | .138 | -4.85 | 0*** |

**Table 4:** OLS Regression of change in EI

| VARIABLES | (1)<br>$\vec{\Delta}$ EI | (2)<br>$\vec{\Delta}$ EI | (3)<br>$\vec{\Delta}$ EI | (4)<br>$\vec{\Delta}$ EI |
|---|---|---|---|---|
| ESE(t1) | -0.0956** | 0.0238 | 0.0294 | 0.0461 |
| | (0.0336) | (0.685) | (0.596) | (0.355) |
| Male | 0.356*** | 0.497*** | 0.484*** | 0.433*** |
| | (0.00520) | (0.00199) | (0.00159) | (0.00206) |
| GPA | -0.0718 | -0.0367 | -0.0178 | 0.0241 |
| | (0.577) | (0.819) | (0.905) | (0.861) |
| Constant | 0.957 | -0.238 | -0.376 | -0.691 |
| | (0.226) | (0.797) | (0.665) | (0.391) |
| Ceiling and floor effect control | NO | Without Quartile 1 and 4 | Without Quintile 1 and 5 | Without Sextile 1 and 6 |
| Observations | 1,400 | 760 | 840 | 958 |
| R-squared | 0.057 | 0.094 | 0.082 | 0.080 |

Robust p-values in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Fixed Effect by Semester and Professor are Included

**Table 5:** OLS Regression of change in ESE

| VARIABLES | (1)<br>$\vec{\Delta}$ ESE | (2)<br>$\vec{\Delta}$ ESE | (3)<br>$\vec{\Delta}$ ESE | (4)<br>$\vec{\Delta}$ ESE |
|---|---|---|---|---|
| EI(t1) | -0.0812*** | 0.106*** | 0.0974*** | 0.0944*** |
| | (0.00590) | (0.00674) | (0.00411) | (0.00305) |
| Male | -0.166 | -0.184 | -0.183 | -0.166 |
| | (0.118) | (0.157) | (0.119) | (0.128) |
| GPA | 0.101 | 0.0460 | 0.0780 | 0.0744 |
| | (0.382) | (0.740) | (0.535) | (0.531) |
| Constant | 0.483 | 0.112 | -0.119 | -0.0870 |
| | (0.466) | (0.887) | (0.868) | (0.899) |
| Ceiling and floor effect control | NO | Without Quartile 1 and 4 | Without Quintile 1 and 5 | Without Sextile 1 and 6 |
| Observations | 1,400 | 710 | 830 | 944 |
| R-squared | 0.069 | 0.106 | 0.096 | 0.090 |

Robust p-values in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Fixed Effect by Semester and Professor are Included