Descifrando mentes emprendedoras: factores clave que influyen en las decisiones de emprendimiento de estudiantes universitarios. Estudio de caso en una universidad colombiana

Decoding entrepreneurial minds: key factors influencing entrepreneurial decisions of university students. A case study at a colombian university

Decifrando mentes empreendedoras: fatores-chave que influenciam as decisões de empreendedorismo de estudantes universitários. Estudo de caso em uma universidade colombiana

- Artículo de investigación -

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Resumen

Este estudio busca comprender cómo diversos factores educativos, de experiencia de vida, socioeconómicos y psicológicos influyen en la decisión de los estudiantes universitarios de Colombia para emprender, identificando cuáles prevalecen en sus elecciones empresariales. Se realizó una revisión sistemática de la literatura y una encuesta a 491 estudiantes de una universidad colombiana. El análisis de los datos se llevó a cabo utilizando el algoritmo Random Forest, el cual permitió evaluar la

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importancia de distintas variables en la decisión de emprender. Se encontró que la educación tiene un impacto significativo en fomentar la intención empresarial, mientras que las experiencias de vida no mostraron un efecto considerable. Los factores socioeconómicos, como el género, demostraron influencia, y los factores psicológicos, como la motivación y la aversión al riesgo, fueron determinantes críticos. Los hallazgos sugieren que es crucial diseñar estrategias de fomento a la empresa considerando estos factores dominantes. La educación universitaria, al proporcionar formación y conciencia sobre el emprendimiento, juega un papel fundamental en la formación de futuros empresarios. Estos resultados son vitales para las instituciones educativas que buscan potenciar un ecosistema emprendedor eficaz.

Palabras clave: emprendimiento empresarial, estudiantes universitarios, toma de decisiones, Random Forest, programas educativos

Abstract

This study seeks to understand how various educational, life experience, socioeconomic and psychological factors influence the decision of Colombian university students to start a business, identifying which ones prevail in their business choices. A systematic review of the literature and a survey of 491 students from a Colombian university were carried out. The data analysis was carried out using the Random Forest algorithm, which made it possible to evaluate the importance of different variables in the decision to undertake. Education was found to have a significant impact on fostering entrepreneurial intention, while life experiences did not show a considerable effect. Socioeconomic factors, such as gender, demonstrated influence, and psychological factors, such as motivation and risk aversion, were critical determinants. The findings suggest that it is crucial to design business promotion strategies considering these dominant factors. University education, by providing training and awareness about entrepreneurship, plays a

fundamental role in training future entrepreneurs. These results are vital for educational institutions that seek to promote an effective entrepreneurial ecosystem.

Keywords: entrepreneurship, university students, decision-making, Random Forest, educational programs

Resumo

Este estudo busca compreender como diversos fatores educacionais, de experiência de vida, socioeconômicos e psicológicos influenciam a decisão de estudantes universitários colombianos de iniciar um negócio, identificando quais prevalecem em suas escolhas empresariais. Foi realizada uma revisão sistemática da literatura e uma pesquisa com 491 estudantes de uma universidade colombiana. A análise dos dados foi realizada por meio do algoritmo Random Forest, que possibilitou avaliar a importância de diferentes variáveis na decisão de empreender. Descobriu-se que a educação teve um impacto significativo na promoção da intenção empreendedora, enquanto as experiências de vida não mostraram um efeito considerável. Fatores socioeconômicos, como gênero, demonstraram influência, e fatores psicológicos, como motivação e aversão ao risco, foram determinantes críticos. Os resultados sugerem que é crucial conceber estratégias de promoção empresarial considerando estes factores dominantes. O ensino universitário, ao proporcionar formação e sensibilização para o empreendedorismo, desempenha um papel fundamental na formação de futuros empreendedores. Estes resultados são vitais para as instituições de ensino que procuram promover um ecossistema empreendedor eficaz.

Palavras-chave: empreendedorismo empresarial, estudantes universitários, tomada de decisões, Random Forest, programas educativos

Introduction

Identifying the profile of entrepreneurial students is of great importance for universities, as it facilitates a more targeted approach to fostering programs and resources aimed at promoting and supporting entrepreneurship among their students. It should be noted that not everyone desires to be an entrepreneur.

In some countries, entrepreneurship is deeply rooted in social and everyday reality, allowing anyone to start a business whenever they wish. However, in other places, socioeconomic, cultural, and other factors may hinder access to or immersion in entrepreneurship. This supports the aforementioned premise (Mason & Brown, 2014).

There are legal, social, economic, and technological barriers that negatively affect the rate of entrepreneurship creation. In response to this context, government leaders formulate public policies focused on entrepreneurial promotion, especially targeting university students and the young population, with universities being key actors in these policies (Arteaga-Espitia et al., 2019).

Higher education institutions establish strategies to promote entrepreneurship. Some may argue that universities replace the role of the state by creating conditions for university entrepreneurship (Giroux, 2009), a debatable and valid stance if the university's goal is limited to promoting entrepreneurship, becoming what is referred to as an "entrepreneurial university" (Arroyo Vázquez, 2016; Echerman, 2011; Rey, 2015). However, this contradicts the true role of the university in society.

The university has the responsibility to educate individuals with critical thinking skills and contribute to the common good (Ortega y Gasset, 1966). Its foundation is to be a space for rigorous and intellectual learning that promotes societal progress and innovation generation (Ortega y Gasset, 1966). Although entrepreneurship fits into this mission as a positive externality, it should not be the central focus of the

university. Therefore, entrepreneurship promotion policies must be integrated into the institution's entire mission.

However, the intersection between this university intentionality and the premise that not everyone desires to be an entrepreneur poses a challenge. Entrepreneurship promotion policies would be more effective if they are specifically targeted at those who have the desire to undertake entrepreneurial endeavors. Therefore, universities must strive to identify and characterize their student population to direct their efforts towards those inclined to entrepreneurship.

In this context, this document presents the results of a survey conducted among students at a Colombian university. For its preparation, a systematic literature review was conducted, allowing for the identification of dimensions of entrepreneurial decision analysis, from which hypotheses and questions were formulated. These dimensions include education, life experiences, socioeconomic factors, and psychological factors.

The first hypothesis suggests that education positively influences the decision to undertake entrepreneurial endeavors, with university support and entrepreneurship training as motivating factors. The second hypothesis focuses on life experiences, where favorable or unfavorable conditions may influence students' entrepreneurial choices. The third hypothesis highlights the importance of socioeconomic factors, such as age, gender, geographic location, salary, and family environment, which also influence the decision to undertake entrepreneurship. Finally, the fourth hypothesis focuses on psychological factors, such as motivation, risk aversion, creativity, and emotional intelligence, which play a decisive role in the decision to undertake entrepreneurship. This study seeks to understand how these dimensions interact and which factors prevail in the entrepreneurial choices of university students in the context of developing countries.

The survey covered 491 students, of whom 37.27% were entrepreneurs or aspiring entrepreneurs. Various variables were considered, such as academic program, current semester, age, gender, and marital status.

It was observed that programs in economic and business sciences concentrated most entrepreneurs, explained by the application of knowledge in their own businesses or entrepreneurship using previously acquired skills. It was also found that students in the second and third semesters showed more interest in entrepreneurship than those in the first, fourth, and ninth semesters, and that women predominated among entrepreneurs.

Analysis using the Random Forest algorithm identified the most influential variables in the decision to undertake entrepreneurship. Among them, self-identification with business competencies, the current academic semester, age, perception of obstacles, and consideration of priorities when starting a business were highlighted. Additionally, the importance of entrepreneurship training and awareness linked to the educational level of entrepreneurial students was emphasized.

Finally, the profile of the entrepreneurial student was identified as one characterized by self-identification with business competencies, being in the fifth or seventh academic semester, aged between 20 and 39 years, and perceiving opportunities and obstacles when undertaking. Common obstacles such as lack of funding and poor project development were identified. It is relevant to consider these variables when designing entrepreneurship promotion strategies, providing financial support and training to students interested in entrepreneurship.

The study yields insightful results regarding the proposed hypotheses. Firstly, it confirms that education significantly influences the decision to undertake entrepreneurship among university students. However, the second hypothesis is refuted, as life experiences do not prove to be a relevant factor in entrepreneurial desire. The third hypothesis is partially validated, showing that socioeconomic

factors, such as gender, play a role in this choice. Finally, the fourth hypothesis is fully corroborated, emphasizing the importance of motivation, recognition of competencies, and risk aversion as key determinants in students' entrepreneurial drive.

Literature review

Identifying the profile of entrepreneurial students is crucial for universities, enabling a more precise focus on programs and resources aimed at promoting and supporting entrepreneurship. It is necessary to consider the premise that not everyone desires to be an entrepreneur.

Entrepreneurship is understood as a form of employment available to individuals (Rentería Pérez & Enríquez Martínez, 2006). Londoño-Cardozo (2018) defines entrepreneurship as the act of initiating or creating a mode of work known in some places as self-employment, based on establishing an organization to meet economic or social needs not addressed by existing modes of work.

In developing countries, entrepreneurship is considered crucial due to its positive impact on economic growth. The decision to undertake entrepreneurship in university students has been studied, identifying factors such as entrepreneurial intention and motivation as relevant references (Belás et al., 2017).

Institutional factors, such as perceived support from universities, are decisive for the decision to undertake entrepreneurship. Institutional support, research, and entrepreneurship courses offered by faculties are essential for the emergence of startups, spin-offs, and student ventures (Bergmann et al., 2016).

Students' participation in entrepreneurial processes is affected by factors such as family environment, poverty, curriculum, and the desire to meet consumption

patterns (Kabonga & Zvokuomba, 2021). Additionally, geographic location and socioeconomic conditions negatively influence the entrepreneurship creation rate (Bravo García, Araque Jaramillo, et al., 2021; Mendoza et al., 2021; Webster & Kontkanen, 2021).

Various factors, such as gender, age, education, work experience, attitudes toward risk, and sociocultural aspects, influence the decision to undertake entrepreneurship. The COVID-19 pandemic has had a significant impact on entrepreneurial behavior, highlighting the importance of considering psychological factors such as the ability to cope with fear and anxiety in times of uncertainty (Doanh et al., 2021).

From the literature review, dimensions were constructed that compose the decision to become an entrepreneur in university students in Colombia: education, life experiences, socioeconomic aspects, and psychological factors (Imbachi Quinayas, 2023; Lemos Bernal, 2022; Lemos Bernal & Londoño-Cardozo, 2024).

Regarding the first dimension, education positively influences the decision to undertake entrepreneurship among university students in Colombia. Institutional guidance and support can influence their choice, especially if they receive entrepreneurship training during their academic formation (Ministerio de Educación Nacional, 2011; Rocha Jácome & Giraldo Gómez, 2015; Torres-Ortega & Campos, 2021). The hypothesis is proposed:

H1: Education positively influences the decision to undertake entrepreneurship in UNIMINUTO students.

The second dimension, related to life experiences, includes factors such as work experience, household size, and family marital status. These experiences positively influence the decision to undertake entrepreneurship, either motivating due to

unfavorable conditions or providing successful examples within the family (Bravo García, Benavides Bustos, et al., 2021). The hypothesis is proposed:

H2: Students' life experiences influence the decision to undertake entrepreneurship in university students.

The third dimension focuses on socioeconomic factors, which have a significant impact on the decision to undertake entrepreneurship. Age, gender, geographic location, salary, and family environment play a determining role (León Mendoza, 2017; Torres Marín et al., 2019). The hypothesis is proposed:

H3: Socioeconomic factors determine the decision to undertake entrepreneurship in university students.

The fourth dimension addresses psychological factors such as motivation, risk aversion, creativity, and emotional intelligence, which are determinants in the decision to undertake entrepreneurship (Ajzen, 1991; Benítez Aguilar & Riveros Paredes, 2022; González Sierra, 2015; Mueller & Thomas, 2001). The hypothesis is proposed:

H4: Psychological factors are determinants in the decision to undertake entrepreneurship in university students.

These hypotheses provide a theoretical framework for analyzing the survey results and understanding how these dimensions interact in the decision to undertake entrepreneurship among university students in Colombia.

Research methodology

This is a mixed-methods research study. It is considered of this nature because this type of research "provides multiple ways to approach a research problem" (Creswell

& Plano Clark, 2018, p. 34) and offers the researcher a certain flexibility by providing a broader range of outcomes (Gibson, 2017; Molina-Azorin et al., 2017; Turner et al., 2017). In mixed methods, the researcher rigorously collects and analyzes qualitative and quantitative data in response to research questions and hypotheses, integrates (or mixes or combines) the two forms of data and their results, organizes these procedures into specific research designs that provide the logic and procedures for conducting the study, and frames these procedures within theory and philosophy (Creswell & Plano Clark, 2018, p. 39).

The study combines qualitative techniques and data with quantitative analysis methods to identify trends in the decision to undertake entrepreneurship among university students. The methodology consisted of two stages: a systematic review of scientific literature and the design of a survey directed at university students. The identification of the dimensions of analysis was carried out following the principles of operationalization of qualitative variables by González Blasco (1986), Cea D'Ancona (2001), and Arenas-García (2021), among others. The systematic review followed the guidelines of García Molina & Chicaíza Becerra (2011) and Chicaíza-Becerra et al. (2017). The collected information was analyzed using the Random Forest method in R Studio.

Data Collection

The study utilized both primary and secondary sources of information. Primary sources include the results from the survey of university students, while secondary sources consist of academic documents and research works consulted during the literature review.

Systematic Literature Review

The procedure followed the steps outlined by Chicaíza-Becerra et al. (2017) for document search and analysis in this study. The first stage involved an exploratory

search to define criteria for a more focused search. The second stage was the actual search on Web of Science and Redalyc. The third step involved the analysis of the found documents using reading matrices. A comprehensive outcome of this review is available in the work by Lemos Bernal & Londoño-Cardozo (2024).

Information Collection Survey

The construction of the survey instrument was based on the dimensions derived from the literature review (Table 1), using the principles of operationalization of qualitative variables. It is assumed that the phenomenon to be observed is complex, and the underlying reasons are vague (Sánchez Espada et al., 2018; Sánchez Sánchez, 2007) "and, consequently, not directly observable" (Cea D'Ancona, 2001, p. 115). Therefore, it is crucial to break down the phenomenon into concepts or dimensions for precision (Arenas-García, 2021; González Blasco, 1986).

Given the methodological and theoretical impossibility of encompassing all dimensions of a phenomenon, it is imperative to agree on the number of dimensions to implement for measurement, ensuring clarity in their understanding, delimitation, and operationalization (González Blasco, 1986).

Each dimension encompasses variables and subvariables, known as indicators (González Blasco, 1986; Merton, 2002) These indicators are operational terms that allow the numerical manipulation of qualitative variables in exchange for a loss of conceptual richness in the phenomenon (Cea D'Ancona, 2001; González Blasco, 1986).

Table 1. Dimensions for analyzing the decision to undertake entrepreneurship among university students

Dimension	Indicator	Definition
Educational level	Influence of university education	This education influences the decision to become an entrepreneur, as its contents motivate students to start a business venture.
	Influence of pre-university education	The person started their university studies with the idea of learning to become an entrepreneur or to apply the knowledge to their business venture, due to the sensitizations received during pre-university education.
Life experiences	Work experience	They are motivated to start a business by something they are doing or learning to do.
	Entrepreneurship experience	It arises from solving a need that they already know or have an idea of how to do it.
	Success stories	They are motivated by seeing or hearing about businesses with similarities to their own.
	Migratory status	The fact of having migrated is a motivator for entrepreneurship, as new cultures attract new ideas.
	Marital status	A successful or failed relationship can motivate a person.
Socioeconomic aspects	Age	To older age, higher probability of entrepreneurship
	Gender	Women start businesses faster than men
	Country, city, or region	There is a variety of influences depending on the location
	Social-cultural environment	Social problems and how to solve them have an impact
	Salary	The desire to increase monthly income is a factor
	Household	Improving the quality of life for the family, especially if one is the head of household.

Dimension	Indicator	Definition
Fear of failure	Uncertainty	The entrepreneur is not willing to take risks easily.
	Decision-making ability	Facing the future with doubts, whether it will happen or not.
	Creativity-innovation	The ability to make decisions is of great value.
	Emotional intelligence	Creating new products or services and implementing them appropriately.
	Uncertainty	Accepting situations and finding appropriate solutions.

Source: Own elaboration

Sample Size

A survey was designed for students of the Corporación Universitaria Minuto de Dios - Rectoría Suroccidente, Sede Cali - Colombia, based on the dimensions outlined in Table 1. The students at this university are heterogeneous, belonging to 23 academic programs across different faculties, totaling 2,220 students. A sample size of 328 students was calculated with a confidence level of 95% and a margin of error of 5% using the SurveyMonkey tool (2022).

Instrument

This instrument consisted of three sections and a total of 35 closed-ended single-response questions. The instrument proposed by Caro-González et al. (2016) served as a reference. Section one addressed characterization questions, grouping academic programs by faculties and related programs to avoid low participation from programs with fewer active students. Nine categories of academic programs were created, covering variables such as age range, gender, region of residence, monthly income, marital status, the status of the high school where secondary education was completed, current employment status, academic program, and periods studied.

Additionally, the population was divided into two groups: students who have undertaken entrepreneurial ventures and those who have not.

In section two, questions about students' self-perception and attitudes toward entrepreneurship were addressed, based on Valencia Beltrán et al. (2013). Students were asked about their perception of their special abilities for entrepreneurship, their assessment of those abilities, perception of the difficulty of starting businesses in Colombia, their capabilities and competencies, as well as entrepreneurship competencies received at different school levels in Colombia, and experiences in their own lives and those of people in their close circle (Valencia Beltrán et al., 2013).

Section three addressed questions about students' perception of entrepreneurship and their university, based on the instrument by Correa Correa et al. (2011). The goal was to understand their knowledge of entrepreneurship promotion and support programs offered by the university, as well as the necessary tools for supporting entrepreneurs from the students' perspective.

Data analysis

Classification trees

The analysis of the information will be carried out using the Random Forest method. This method of analysis is based on classification trees. Like regression trees, classification trees use splitting rules in successive binary partitions through the selection of a variable and a cut-off point that minimizes an impurity function (Charbuty & Abdulazeez, 2021; Dietterich, 2000).

In other words, given a set of observations of size n (node t or parent node) consisting of observations belonging to two or more different classes (heterogeneous set), the fundamental idea of a classification tree is to split the set into two subsets (child nodes tS and tN, with sizes n1 and n2, respectively) that are

globally more homogeneous than the parent node. The subscripts S and N refer to a node splitting rule, consisting of a condition that is either satisfied (S) or not satisfied (N). However, it is necessary to 1) measure the heterogeneity or impurity of a node and 2) define the rule on which the algorithm is based to split the parent node into two more homogeneous or pure children.

To calculate the degree of homogeneity achieved by dividing a parent node t (with n observations) into its two child nodes tS and tN (with n1 and n2 observations, respectively), the difference between the impurity index of the parent node and the sum of the weighted impurity indices of the child nodes is calculated. This difference is called gain or improvement in homogeneity.

$$\Delta Homogeneity = Impurity_t - \frac{n_1}{n} Impurity_{t_s} - \frac{n_2}{n} Impurity_{t_N}$$

There are different measures of impurity, with the most commonly used being the Gini index.

$$G(t) = 1 - \sum_{j=1}^{J} p_j^2$$

The index is bounded in the interval [0, 1]. Values close to 0 indicate greater homogeneity or purity, while high values close to 1 indicate low purity, meaning a lot of class mixing or heterogeneity.

The splitting rule is carried out by selecting a variable xi and a cut-off point c. The n observations in the parent node are divided based on whether the condition $xi \geq c$ is met. All observations that satisfy the condition go to the child node t_S, while those that do not satisfy the condition ($xi < c$) go to the child node t.

This operation is repeated in each new node until a certain stopping criterion is met:

. Number of observations in the node: A minimum number of observations in a node is set, below which it is considered terminal.
. Purity: If the proportion of a majority class in a node is greater than a specified threshold, the node is considered terminal.
. $\Delta homogeneity(t, q)$: If the homogeneity gain generated by the splitting rule of a node t based on a condition q is very small and falls below a fixed minimum, it is considered a terminal node.

To classify a new observation falling into a specific terminal node, it is assigned the majority class or category (with the highest proportion) in that node. It should be noted that if all observations in a terminal node belong to the same class, the entropy and Gini indices will have a value of 0, indicating that the purity of the node is total, and there is no classification error. If there is a mix of classes in a terminal node, the majority class is assigned, but there may be some classification error.

Random forest

Decision trees form the starting point of Random Forest. To achieve higher accuracy in the classification predicted by a model, a straightforward and intuitive procedure can be employed. Instead of implementing a single classification model, it is better to combine many them. This is the basis of the technique known as Random Forest (Cutler et al., 2012).

Random Forest combines a set of models based on classification trees. In the Random Forest ensemble, many unpruned trees are implemented. Each tree in the forest provides an estimate for the class of a new observation, and the most numerous classes, voted by the majority of the classification trees (voting), becomes the final class assigned to the observation (Antoniadis et al., 2021; Breiman, 2001).

The training data (n observations and k independent variables) are the same for all trees, so the result of each tree is the same. For this reason, each tree in the forest consists of:

. A different data sample of size n compared to the rest of the trees (bootstrap).
. A different subset k' of the independent variables used in the construction of each tree.

In addition to classifying the category of a new observation, Random Forests are highly valued because they provide a ranking of the importance or significance of the independent variables on the dependent variable. This technique was proposed by Breiman (2001) and is known as bagging. Its name implies two processes: Bootstrap and Aggregating. This ranking can be used to reduce the number of variables introduced in other implemented models.

Aggregating

Each tree generates a classification for the response variable of a new observation. The final class assignment is calculated by adding the results of all classifiers. This is done through voting (the most voted category) or soft-voting (giving greater weight to models with a higher probability of correctness or lower classification error); this process is known as Aggregating (Zhan et al., 2021).

Bootstrap

Bootstrap is a data sampling technique. If L different models are to be implemented (L trees, in the case of Random Forest) on a dataset of n observations, L samples of size n are taken. To ensure they are not identical, the selection of observations is carried out as a replacement extraction system. Therefore, there are L samples of n observations where, having been extracted with replacement, some are repeated in

each, and others are left out. The observations that do not belong to a sample l form the out-of-bag (OOB) of that sample (Mohana et al., 2021).

Ranking of Variable Significance

Using the out-of-bag observations, Random Forest calculates two additional metrics: Mean Decrease Accuracy (MDA) and Mean Decrease Gini (MDG).

. For both metrics, a variable is left out of the model testing, and the following are calculated:
. MDA: the average difference between errors with and without the variable concerning the total errors.
. MDG: the average increase in the Gini index across all nodes.
The higher the MDA or MDG, the greater the importance of the variable in the model.

Results and discussion

The survey for this research was conducted among all university students, without exception, to identify the characteristics of those who have started a business or wish to do so in the future, as contrasted with those who do not desire or have not undertaken such ventures. The results were divided into two main sections: the first presents a general overview of the findings, focusing on students who wish to or have already embarked on entrepreneurship, and some relevant variables to identify the profile of the entrepreneurial student. The second section corresponds to the analysis of the results and the relevant variables using the Random Forest methodology.

Descriptive characteristics of the participating population

Firstly, it should be noted that 491 students responded to the research call (Table 2). Of this total, 37.27% have already embarked on entrepreneurship or express a

desire to do so in the future, which equates to 183 students. From this point forward, all presented data pertain to students who have engaged in entrepreneurship or express a desire to do so, as the research focuses on identifying their profile and the variables that differentiate them from the opposing group. Methodologically, students expressing a desire to venture into entrepreneurship or those susceptible to being sensitized to entrepreneurship were considered as those who had already decided to do so. It is anticipated that students aspiring to entrepreneurship in the future share similar characteristics with those who have already taken entrepreneurial steps. This is in line with the principle of isomorphism in institutions (DiMaggio & Powell, 1999; Peters, 2019) present in Colombian society.

Table 2. Distribution of students according to their participation in entrepreneurship

Not started a business	Started a business	Total participants
308	183	491

Source: Own elaboration

The participation by academic programs within the university's entrepreneurial population predominantly revolves around students in economic and business sciences programs, as indicated in Table 3. This is to be expected, considering that many students enroll in these programs with the aim of acquiring knowledge to apply in their personal businesses. Additionally, some students apply the knowledge gained in the university to a pre-existing art or craft and decide to become entrepreneurs (Salcedo Serna et al., 2021).

Table 3. Survey participation by academic program

Degree programmes	Percentage
Health and safety management	5%
Management*	26%
Journalism	2%
Accountancy*	30%
Industrial engineering	10%

Degree programmes	Percentage
Teacher training programs (Bachelor of Education)	3%
Psychology	5%
Higher national diplomas (HND) or technology programs*	11%
Social work	7%

Note: Programs marked with an asterisk (*) correspond to Business Science programs.
Source: Own elaboration

The distribution by semester among the students is homogeneous, ensuring a representative sample, as shown in Table 4. However, there is an absence of participation from eighth-semester students. This could be due to two possible reasons: 1) no eighth-semester student has embarked on or desires entrepreneurship, or 2) students at this academic level chose not to participate in the study. Nevertheless, based on the data, it is impossible to identify the reason for this outcome. Methodologically, all students were sought. On average, approximately 10% of students from each semester have engaged in entrepreneurship. This information is crucial for formulating promotion strategies that ensure the effectiveness and efficiency of institutional resources. It was identified that a higher percentage of progress in the academic career correlates with a greater likelihood of wanting to undertake entrepreneurial initiatives. It is also noteworthy that students in the second and third academic semesters demonstrated a greater interest in entrepreneurship than those in the first, fourth, and ninth semesters.

Table 4. Survey participation by academic level

Semester	Porcentage
I Semester	9%
II Semester	13%
III Semester	12%

IV Semester	9%
IX Semester	7%
V Semester	10%
VI Semester	10%
VII Semester	13%
X Semester	17%

Source: Own elaboration

Building upon the theory, one of the most relevant criteria for understanding the population that chooses to undertake entrepreneurial endeavors is gender. According to the results, what is considered in the theory is fully supported among the university students. Women are the predominant group of entrepreneurs (Table 5). This finding is significant because, similarly, women constitute the most represented demographic group in the university and exhibit some specific characteristics.

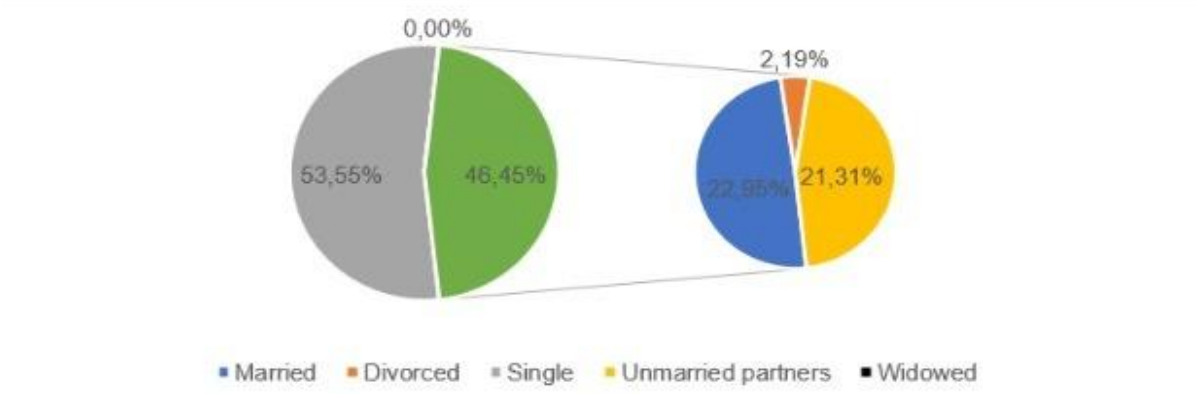
Table 5. Gender classification of students who have undertaken entrepreneurship

Gender	Percentage
Female	75%
Male	25%
Other	1%

Source: Own elaboration

Another variable worth highlighting to characterize the entrepreneurial population of the university is marital status. Figure 1 illustrates the population composition concerning this variable. It is evident that most of the entrepreneurial population is single. However, the influence of partners or the existence of marriage or unmarried partners seems to be significant, as it consolidates as the second-highest frequency in the population. Despite this, the conclusive utility of this variable in identifying potential prospects for entrepreneurial students remains uncertain.

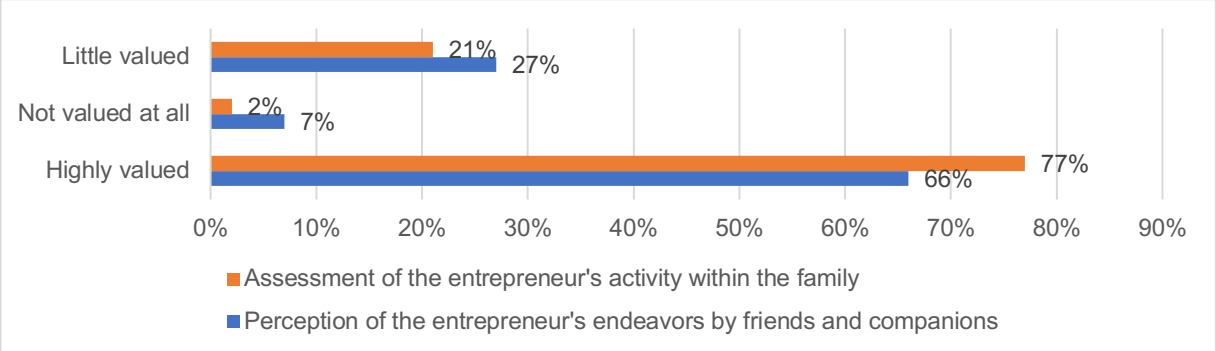
Figure 1. Marital Status of Entrepreneurial Students



Source: Own elaboration

Regarding their family and friends' environment, entrepreneurship is identified as having high social value, as shown in Figure 2. This can have a significant impact on their motivation and the success of their project. If family and friends perceive the social value of entrepreneurship, they are more likely to provide emotional and financial support, which can make the entrepreneur feel more motivated and committed to their project or decide to initiate one.

Figure 2. Acceptance of entrepreneurial activities by the entrepreneur's close circle

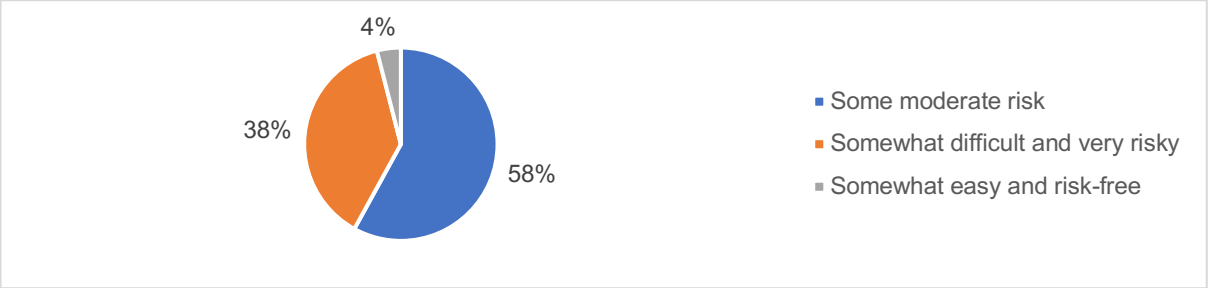


Source: Own elaboration based on the authors

Regarding the perception of risk, Figure 3 shows that the study population considers entrepreneurship to be an activity with moderate risk. This perception can have positive or negative implications for the entrepreneur, depending on their own risk

perception associated with their business. If the entrepreneur also believes that the risk is moderate, they can plan their strategy and make informed decisions. Conversely, if the entrepreneur perceives the risk as high, it may generate fear and uncertainty, limiting their growth.

Figure 3. Perception of the risk of entrepreneurship



Source: Own elaboration based on the authors

Analysis Using Random Forest

When applying Random Forest, the variables that have the most impact on the studied phenomenon are identified, as shown in Table 6. In other words, a classification is generated regarding the response variables with the greatest impact on the students' decision to undertake. Figure 4 presents the results obtained from the Random Forest analysis.

Table 6. Variables in order of importance

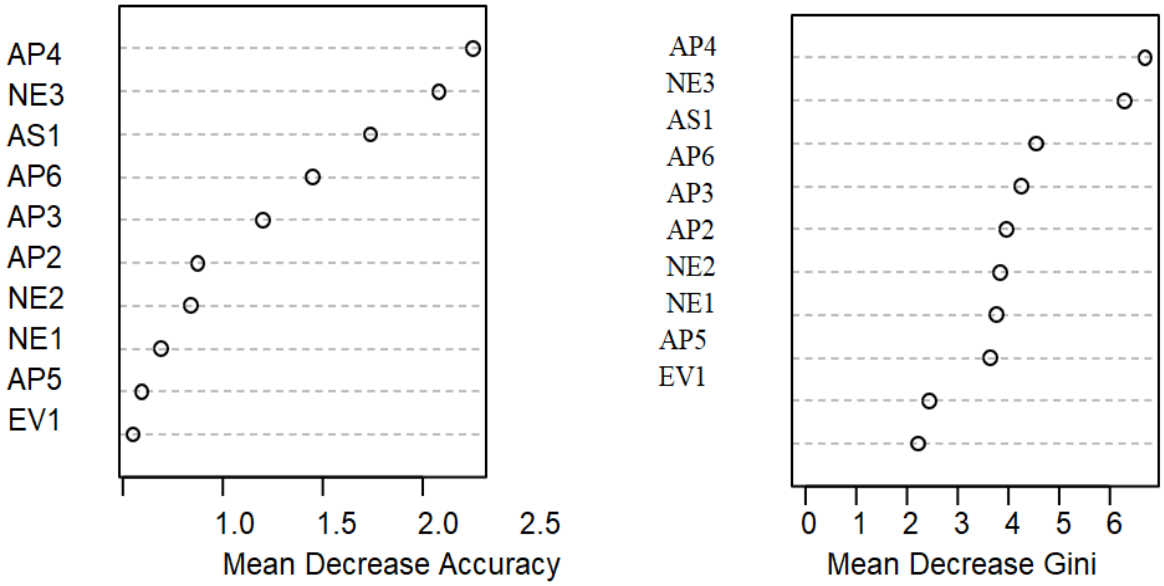
AP4	**Self-identification of competencies**
NE3	Current academic semester
AS1	Age of the entrepreneur
AP6	Personal assessment of one's own entrepreneurial abilities
AP3	Self-identification regarding entrepreneurship capabilities
AP2	Perceived obstacles to entrepreneurship
NE2	Current academic major
NE1	Highest level of education achieved by the student

AP5	Consideration of priorities when starting a business
EV1	Main employment situation in the last year

Source: Own elaboration

The importance of each variable in terms of its contribution to the model's accuracy and the relative importance of each variable in the model, as measured by the average decrease in accuracy resulting from its elimination based on the Gini index, is depicted in Figure 4. The final class assignment is calculated by aggregating the results of all classifiers. According to the variables in order of importance, students who have undertaken entrepreneurship consider the most important factor when undertaking to be the competencies they identify with, followed by the semester of university education they are in and their age. Other significant factors include aspects considered important at the time of undertaking and their current employment status.

Figure 4. Model with all observations - confusion matrix and most important variables



Source: Own elaboration

In this section, an analysis of the university entrepreneur's profile will be conducted based on the important Random Forest variables. Analyses of each variable and a general context together will be presented. It should be noted that some of the

variables were already described in the previous section and will not be mentioned in the individual analyses.

The analysis of the competencies with which entrepreneurial students self-identify the most is the subject of Table 7. This analysis suggests that they identify more with responsibility, commitment, leadership, and hard work. This can have significant implications for their decision to become entrepreneurs, as they may focus their entrepreneurial development on these skills. Additionally, the recognition of hard work as one of their competencies in entrepreneurship is commendable. The possibilities that open for students are diverse, such as strengthening these competencies through training and mentoring, which can increase their business success. Furthermore, these results may have implications for education and business development professionals, as they can adjust their training programs to foster these skills in entrepreneurial students.

Table 7. Self-identification of competencies

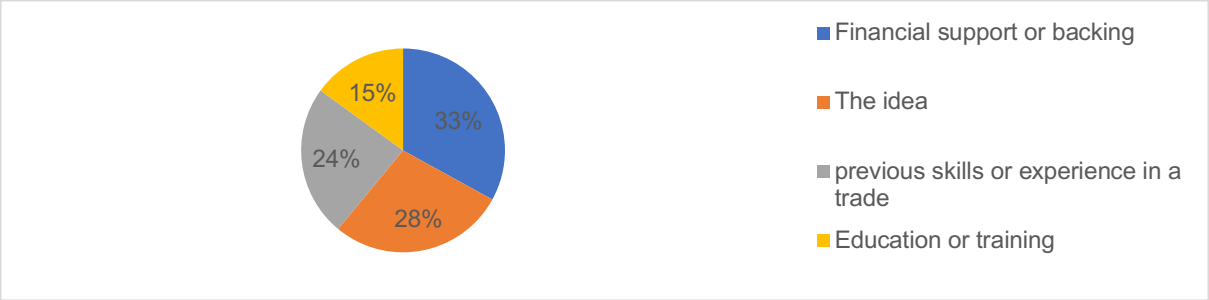
Competence	Percentage
Taking risks	3%
Enthusiasm	3%
Independence	3%
Leadership	12%
Motivating others	5%
Responsibility and commitment	35%
Self-confidence	11%
Creativity and innovation	8%
Decision-making	3%
Working hard	17%

Source: Own elaboration based on the authors

Regarding the variables considered priorities in deciding to become an entrepreneur, the results suggest that entrepreneurial students mainly value economic support and

business ideas, as shown in Figure 5. This implies that, to promote entrepreneurship, university policies should be directed toward seeking financial resources through external support and promoting idea generation. Attention should also be paid to training since, although it was valued to a lesser extent, it remains an important factor.

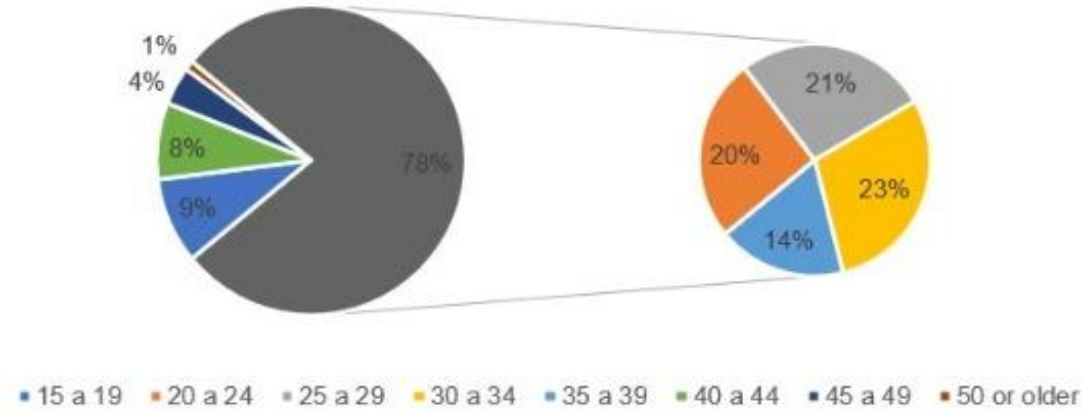
Figure 5. Important aspect to be an entrepreneur.



Source: Own elaboration based on the authors

Concerning the age of entrepreneurial students, as shown in Figure 6, 78% of the students who have undertaken fall within the age range of 20 to 39 years. According to Erikson (1993), this corresponds to the sixth stage of the eight stages of man, where young adults make commitments to work, professions, among others, and consolidate projects related to work, friendship, and family.

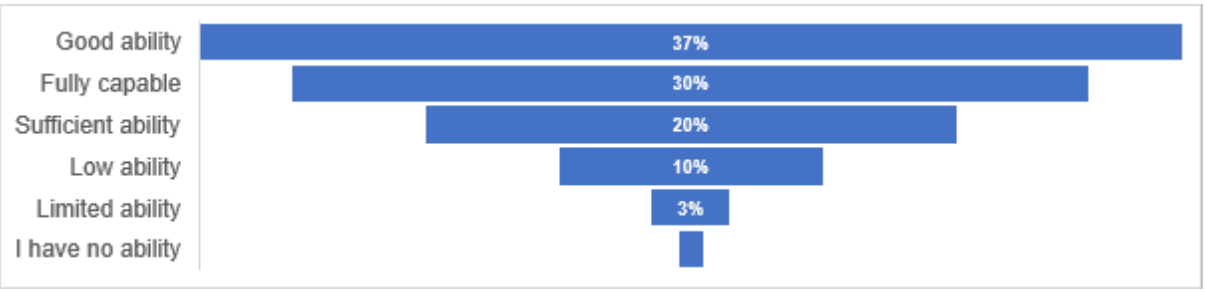
Figure 6. Students who have started a business classified by age range



Source: Own elaboration

The data revealed in Figure 7 indicates that most students perceive themselves as having good to complete ability for entrepreneurship. This suggests that these students have confidence in their entrepreneurial skills and feel prepared to face the challenges of entrepreneurship. However, it is important to note that a significant percentage considers themselves as having sufficient capacity, suggesting that they could benefit from further development of their entrepreneurial skills. On the other hand, there is a small proportion of students who perceive themselves as having little or no capacity, indicating the need for additional support and resources for them to develop their entrepreneurial skills.

Figure 7. Self-assessment of entrepreneurial capabilities



Source: Own elaboration

The results in Table 8 show that entrepreneurial university students self-identify with various personal capabilities for entrepreneurship. A considerable percentage feels capable of leading and communicating effectively with others, recognizing opportunities, and being very creative. However, lower percentages see themselves as capable of problem-solving, developing new products or services, or establishing a network of contacts. These results may imply the need to strengthen specific skills in product development, problem-solving, and establishing professional networks.

Table 8. Self-identification regarding entrepreneurship capabilities

Capability	Percentage
Leadership and effective communication ability with others	25%
Ability to solve diverse problems	14%
Outstanding creativity	21%

Competence in developing products, services, or improvements	8%
Ability to establish personal and professional networks	8%
Efficiency in identifying opportunities	23%

Source: Own elaboration based on the authors

Analyzing the data on perceived obstacles by students (Table 9) highlights several important trends. Firstly, a significant percentage identified the lack of funds or financial resources as a major obstacle. This indicates that the availability of initial capital is a significant concern for entrepreneurial students and may influence their decision to undertake or postpone their projects. Furthermore, a notable percentage of students mentioned the lack of a well-structured project as an obstacle. This suggests that the university could play a key role in providing support and training in developing entrepreneurial skills, helping students create solid and structured business plans. Another group of students pointed out challenges in financing as an obstacle. Finally, a smaller percentage of students mentioned tax considerations and administrative procedures as obstacles.

Table 9. Perceived obstacles faced by students when starting a business

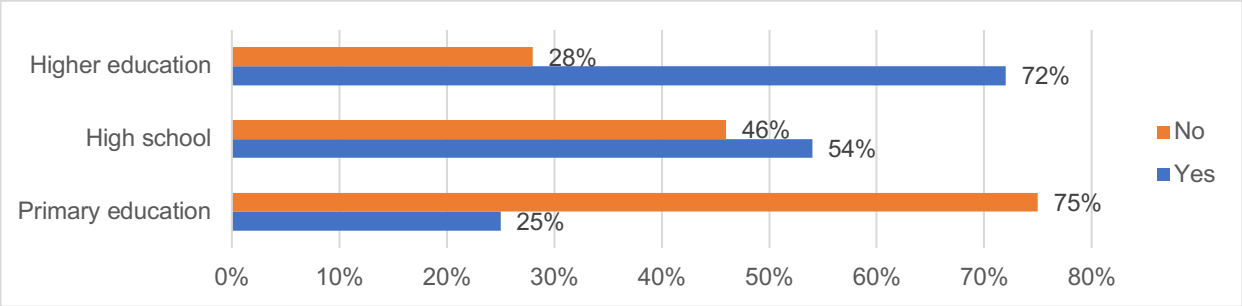
Obstacles	**Percentage**
Lack of ideas	7%
Lack of funds or financial resources	52%
Lack of a well-structured project	16%
Financing challenges	13%
Tax considerations	8%
Administrative procedures and paperwork	5%

Source: Own elaboration based on the authors

Most students who have undertaken entrepreneurial ventures received guidelines or training on entrepreneurship at different educational levels (Figure 8). In general, 75% of respondents stated that they had not received training in entrepreneurial skills in primary education. However, there is a decrease in this indicator when

inquiring about such training in secondary education. This contrasts with 75% of respondents who affirmed receiving training in entrepreneurial skills in higher education. Here, notable efforts by the university and other higher education institutions in training their students in this area are evident. Perhaps government guidelines and efforts to improve the working and economic conditions of students have contributed to the strengthening and participation in entrepreneurship training programs.

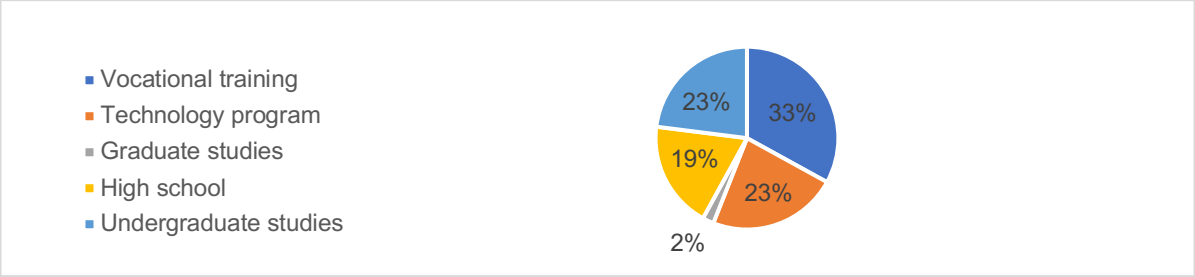
Figure 8. Students who received some kind of guidance or education on entrepreneurship by educational level.



Source: Own elaboration based on the authors

Similarly, most students have pursued higher education studies, with 33% completing a technical career and 23% completing a technological and university career before their current studies (Figure 9).

Figure 9. Highest level of education attained

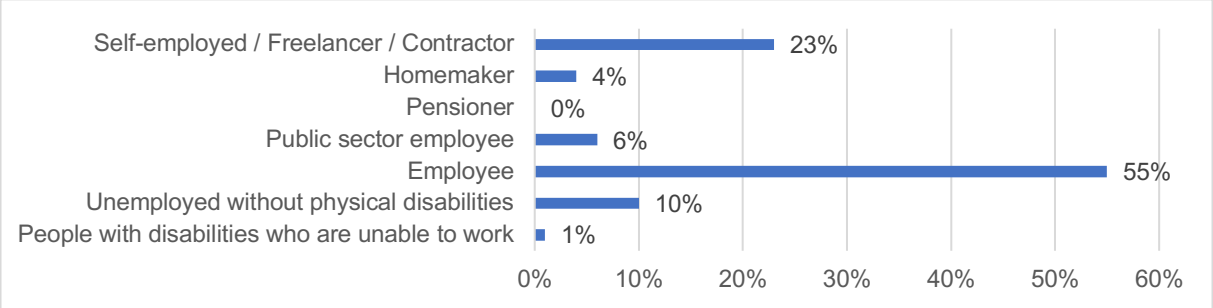


Source: Own elaboration based on the authors

The analysis of the employment situation and income in the last year of entrepreneurial students (Figure 10) indicates that the majority of them were

employed at the time they decided to undertake. These data suggest that employment status and income may have influenced the decision to pursue entrepreneurship, either as an alternative to improve their economic situation or as an opportunity to exercise job autonomy. The fact that more than half of the entrepreneurial students were employed suggests that some may have felt dissatisfied or limited in their previous employment, leading them to seek an entrepreneurial alternative for greater autonomy, personal growth, or higher income. Additionally, the considerable percentage of students who were already self-employed or contractors indicates a predisposition toward entrepreneurship and a preference for a more independent work model.

Figure 10. Main employment status in the last year



Source: Own elaboration based on the authors

In general, the profile of the entrepreneurial student is characterized by self-identification with business skills, their current academic semester, age, personal assessment of their entrepreneurial abilities, identification with entrepreneurship-related skills, perception of obstacles, academic program, educational level, consideration of priorities, and employment status. These aspects together outline the profile of students who decide to undertake entrepreneurial ventures, highlighting their motivation, academic preparation, and willingness to overcome challenges on the path to entrepreneurial success.

Conclusions

Within the overall results of the study, several noteworthy aspects emerge. Firstly, it is interesting to reflect on the percentage of students who have undertaken entrepreneurial activities or wish to do so. The fact that this value is less than 40% of the total sample population reaffirms the assertion that not all people, in this case, students, have the desire to undertake entrepreneurial ventures. This indicates that allocating resources from the university to all its students might motivate some but does not guarantee that this effort reaches students genuinely interested in entrepreneurship.

It is relevant to highlight that, within the entrepreneurial or aspiring population at the university, women represent most of the sample. Furthermore, they perceive the risk of entrepreneurship as moderate. This population is mostly single or without formalized partners according to Colombian guidelines, with a high valuation of entrepreneurship in their family and close friends' environment.

Using the Random Forest algorithm, it was identified that the combination of variables AP4, NE3, AS1, AP6, AP3, AP2, NE2, NE1, AP5, and EV1 constitutes the characteristics that must be considered to identify potentially entrepreneurial students. In other words, individuals who recognize themselves as committed and responsible, are between the fifth and seventh approved academic semester, aged between 20 and 39, and feel capable of undertaking, identify with leadership, and constantly seek opportunities should be considered.

Additionally, this population stated that one of the main barriers or obstacles encountered was the lack of funds or financing options, which relates to a deficiency in project development. It is essential to note that most of these entrepreneurial students had received some type of training or awareness in entrepreneurship, which correlates with their educational level. Many of these entrepreneurial profile students already had a higher education degree at the time of the instrument application, and the absence of employment does not seem to be a motivator.

As for the first hypothesis, it can be concluded that it is validated since education seems to influence the decision to undertake entrepreneurial activities. In this scenario, it is possible to understand that, although most students wishing to undertake or who have undertaken at the university have some other higher education, actions can be channeled to motivate students entering a university for the first time to pursue a degree and become interested in entrepreneurship. However, this boost may be reflected in later stages after the student graduates. It is suggested that the university organizes strategies that allow its graduates to formulate, receive support, and seek funding for entrepreneurial projects generated after their study stage.

On the other hand, the second hypothesis was refuted. The analysis from Random Forest did not identify life experiences of entrepreneurs or those wishing to undertake as relevant. However, the third hypothesis was partially confirmed since socioeconomic factors have a partial influence on the decision to undertake in this student sample. The most influential variable was gender, while salary does not seem to have a real impact. Other variables such as geographic location and home conditions were not relevant for this sample.

In contrast, the fourth hypothesis was fully confirmed. Factors such as motivation, recognition of competencies, and risk aversion significantly and more importantly influence the entrepreneurial decision. In other words, many university policies and strategies could be aimed at strengthening these criteria among students who express a reluctance to undertake or who have just entered a higher education course.

Despite these results, it is necessary to mention some limitations. Firstly, a study covering other campuses of the same university was planned. However, logistical and resource constraints prevented this expansion. It would be important to replicate this same instrument on other campuses. Also, although the university's population has specific characteristics due to UNIMINUTO's social vocation, it would be interesting to replicate the same study at other universities in the city and region to contrast the effectiveness of the selected criteria.

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