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# Influence of the problem-based learning methodology on the intrapreneurial intentions of university students

Pedro Baena-Luna<sup>a,\*</sup>, Isadora Sánchez-Torné<sup>b</sup>, Esther García-Río<sup>c</sup>, Macarena Pérez-Suárez<sup>b</sup>

<sup>a</sup> Department of Business Administration and Marketing, University of Seville, Seville, Spain

<sup>b</sup> Department Applied Economics III, University of Seville, Seville, Spain

<sup>c</sup> Department Economic Analysis and Political Economy, University of Seville, Seville, Spain

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## ABSTRACT

This paper analyzes the impact of the Problem-Based Learning (PBL) methodology, a teaching method that involves working with real-world problems and developing skills for their resolution, on university students' Intrapreneurial Intentions (IIN). A sample of 267 students participated in the study, and their responses were collected at two different times. The data were analyzed using statistical regression analysis and the fs-QCA technique. The results revealed that the PBL methodology significantly improved the behavior of variables associated with potentially intrapreneurial behaviors. Specifically, three components, namely Subjective Norms, Perceived Behavioral Control, and Risk-Taking Capacity, positively influenced undergraduate students' IIN. These findings suggest that the PBL methodology can be a valuable tool for universities in developing initiatives to improve graduate employability.

## 1. Introduction

The labor market increasingly demands university graduates with the knowledge, competencies, and skills acquired during their training and the ability to undertake innovative actions (Gawrycka et al., 2020). These graduates must possess characteristics that facilitate the adoption of new work methodologies, know new channels to access information (Klofsten et al., 2021), and identify and exploit new business opportunities to enable the firm to generate competitive advantages (Marques et al., 2019).

Intrapreneurs are a strong exponent of this increasingly demanded profile (Blanka, 2019). These individuals, who stand out in their work despite organizational limits, are crucial for taking risks and implementing actions that benefit the firm (Fashami et al., 2021). In today's organizations, people are no mere longer replaceable productive resources but can become unique strategic assets (Hendrani et al., 2021). According to CISE (2023), more than 75% of listed companies regularly propose intrapreneurial challenges to their employees. To this end, 67% (of them) allow employees to dedicate time out of their working day to developing these initiatives. This is undoubtedly evidence of the type of labor market university graduates will join once they graduate. In addition, 62% of the firm's current profile of the intrapreneur is that of a worker with a university education and great potential for professional development. This is only possible thanks to their ability to propose innovative solutions and explore new opportunities that drive business growth.

Thus, the study of Intrapreneurial Intention (IIN) is of utmost importance as it allows an understanding of the elements that favor

\* Corresponding author.

E-mail address: [pbaenaluna@us.es](mailto:pbaenaluna@us.es) (P. Baena-Luna).

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intrapreneurial attitudes and behavior (Aydin et al., 2023), a vital aspect of this paper's focus. Although there are works that analyze its behavior in university students, these are scarce and mostly linked to entrepreneurship training, e.g., Fashami et al. (2021), Shaikh et al. (2020) and González-Serrano et al. (2018) and not so focused as way to improve the potential employability of the student.

The reality of the labor market faced by university graduates influences universities to assume that they must be active agents in developing competencies and skills that favor their employability. Consequently, the university should also focus on their development in a way that directly and positively influences student performance and improves their employability (Baena-Luna et al., 2022).

This work fills a significant research gap by considering the reality of the IIN as a phenomenon with its entity (although with some elements shared with EI) that can be positively influenced through collaborative teaching methodologies such as Problem-Based Learning. For this purpose, and after an exhaustive review of the literature, the behavior of these variables has been studied. Specifically, Entrepreneurial Attitude (EA), Entrepreneurial Intention (EI), Subjective Norms (SN), and Perceived Behavioral Control (PBC), according to Liñán and Chen (2009), and the Risk-Taking Capacity (RTC) and Innovation Capacity (INC) regarding of González-Serrano et al. (2019).

The study was carried out at two different times, before and after participating the university students in a subject taught using PBL methodology. Moreover, by analyzing in a novel way the behavior of the variables that affect the IIN in the context of a subject taught with PBL methodology, this undoubtedly opens promising lines of action for universities. We also respond to the request of González-Serrano et al. (2023), in which he raises the need for empirical studies to analyze which activities are most helpful in developing intrapreneurial intentions in students.

The results show that the PBL methodology, applied in university teaching, favors students' acquisition of content and developing skills and competencies related to intrapreneurial behaviors. For this reason, the following research question related to the variables influencing the IIN will be answered in the context of a subject taught with this methodology.

RQ1 What is the behavior of the variables that influence the IIN (SN, EA, PBC, EI, RTC, and INC) of university students who have attended a course taught through PBL methodology?

Previous studies on the IIN have addressed whether gender differences exist in the behavior of the variables with influence, e.g., Yazici (2020), Adachi and Hisada (2017), and Sungkhawan et al. (2012), without an absolute consensus. For this reason, and in agreement with the EU Framework Program for Research and Innovation—Horizon Europe (European Union, 2021), which states that the gender dimension in research brings added value in terms of excellence and in agreement with Turro et al. (2020) who state that intrapreneurship from a gender perspective is still little explored, we have included a research question to analyze the results from this perspective.

RQ2 Are there gender differences in the behavior of variables influencing the IIN of university students participating in a subject taught through PBL methodology?

This paper is structured as follows: after this introduction, in the literature review section, the fundamental concepts of this work are addressed: PBL methodology and IIN in the field of university education. Subsequently, in the methodology section, the critical methodological aspects are presented when collecting, processing, and analyzing the data from which the results are shown. After their study and analysis, the results are discussed, and the most relevant conclusions are presented.

## 2. Literature review and hypotheses

### 2.1. Problem-based learning

PBL originated in training within medicine in Canada toward the end of the 1960s and was later integrated into other disciplines (Mann et al., 2021). It is a person-centered teaching-learning method for acquiring knowledge, skills, and attitudes through real-life situations (Thorndahl & Stentoft, 2020).

This methodology aims to train people capable of reasoning and facing problems as they will potentially do in their future professional activity (Bae et al., 2021). It is an active method whose advantages include the development of competencies and skills (Gallagher & Savage, 2023) as self-learning, lifelong learning, problem-solving, practical thinking, innovation, collaboration, and communication (Li et al., 2019) connected, many of them, with what are considered traits of intrapreneurs (Moriano et al., 2009).

According to Hung (2009), PBL emulates the natural human learning process, moving away from traditional methodologies such as lectures. Learning begins when individuals seek solutions to the problems they face. Individuals learn the skills and knowledge that revolve around a problem and its environment (contextual knowledge) in which it occurs. This author also highlights that, through authentic problems, one learns to contextualize problems, understand the content, and train skills that strengthen solution thinking (Ali, 2019; Sekarwinahyu et al., 2019).

Thus, the students, according to this methodology (Higuera-Martínez et al., 2021; Wosinski et al., 2018): 1) Work collaboratively in small groups. 2) Identify and define problems. 3) Plan solutions. 4) Make decisions based on their analysis of the discovered solution alternatives. All these actions are developed in a self-directed learning environment (Beagon et al., 2019). With all of the above, soft skills such as cooperation, negotiation, and communication, which are very useful in professional activity, are enhanced (Ali, 2019; Dupri et al., 2020).

## 2.2. Intrapreneurial intentions

Intrapreneurs are characterized by approaching their tasks beyond organizational boundaries (Blanka, 2019), generating value for the firm (Chouchane et al., 2023). Although intrapreneurs share many traits with entrepreneurs, they differ mainly because they intend to avoid risking their capital by pursuing their ideas outside the organization (Badoiu et al., 2020). Research that has studied the IIN states that it should focus on the traits of the individual (Douglas & Fitzsimmons, 2013). Thus, as Gawke et al. (2017) highlighted, elements such as the ability to work in a network, the perception of one’s capabilities, and the individual’s self-esteem will be fundamental. Hence, people with entrepreneurial attributes could also be considered potential intrapreneurs in many cases (Buratti et al., 2023).

Some of these elements are linked to previous research on the *Planned Behavior Theory* by Ajzen (1991), such as the influence of Attitude Towards Behavior, understood as the favorable or unfavorable evaluation of the individual concerning a behavior, in our case, intrapreneurial behavior (González-Serrano, 2023). Subjective Norms refer to the perceived pressure to behave in a certain way (Neessen et al., 2019), and Perceived Behavioral Control refers to the individual’s perception of their ability to decide on a behavior (Ajzen, 2020) despite its context (Chouchane et al., 2023). These, in addition, have already been contrasted as elements favoring EI (the individual’s predisposition to entrepreneurial behavior), specifically in works such as that by Liñán and Chen (2009). Along with these elements, González-Serrano et al. (2019) highlight the relevance of the ability to innovate by proposing ideas in different scenarios, thanks to their perception regarding the implementation of original and appropriate ideas developed through one’s own creativity and risk-taking over the perception of being able to assume failure in the face of the possibility of obtaining benefits as a reward for success.

Thus, the fact that intrapreneurs and entrepreneurs share traits makes it possible to analyze IIN together with elements of EI, as factors of entrepreneurial behavior also positively influence potential intrapreneurial behaviors (Baena-Luna & García-Río, 2021).

## 2.3. Link between problem-based learning and intrapreneurial intentions

Research on IIN is not numerous, and even less so in the case of those that relate IIN to a teaching methodology. However, it is possible to identify studies that analyze the impact of PBL on entrepreneurial variables, which, in our case, are used to measure the IIN (see Table 1). This makes it possible to collect previous evidence for a later comparison with results related to IIN.

With the PBL teaching and learning methodology, students face changing situations requiring innovatively solving complex problems (Binkley et al., 2012), thereby favoring the PBC, EA, EI, SN, INC, and RTC. Thus, EI and IIN share independent variables according to some related research. (Baena-Luna et al., 2022; Lara-Bocanegra et al., 2022).

In the context of a subject taught using the Problem-Based Learning Methodology and its connection with the elements that influence the IIN, specifically PBC, EA, EI, and SN, we can establish the following hypotheses based on the research of Liñán and Chen (2009).

**(H1).** Hypothesis 1. University students’ participation in a subject taught using the Problem-Based Learning methodology favors the behavior of the Entrepreneurial Attitude concerning their Intrapreneurial Intentions.

**(H2).** Hypothesis 2. University students’ participation in a subject taught using the Problem-Based Learning methodology favors the behavior of the Subjective Norms concerning their Intrapreneurial Intentions.

**(H3).** Hypothesis 3. University students’ participation in a subject taught using the Problem-Based Learning methodology favors the behavior of the Perceived Behavioral Control concerning their Intrapreneurial Intentions.

**(H4).** Hypothesis 4. University students’ participation in a subject taught using the Problem-Based Learning methodology favors the behavior of Entrepreneurial Intentions concerning their Intrapreneurial Intentions.

Similarly, and based on the connection of the PBL methodology with the INO and RTC elements and on the work of González-Serrano et al. (2019), who found the positive influence of these elements in the Intrapreneurial Intentions of university students, we can establish the following hypotheses.

**(H5).** Hypothesis 5. University students’ participation in a subject taught using the Problem-Based Learning methodology favors the behavior of the Innovation Capacity concerning their Intrapreneurial Intentions.

**Table 1**

Examples of literature connecting PBL methodology with IIN elements.

Connection PBL methodology with IIN elements	Authors
INC training through problem-solving.	San Tan and Frank Ng. (2006)
Improving EA, EI, SN, PBC, RTC, and INC.	Santateresa (2016)
Improving employability through proactivity and EI.	Castelan and Bard (2018)
Improved perception of safety when putting into practice the theoretical knowledge acquired.	Mcdonald et al. (2018)
Favoring of INC.	Tuzlukova and Heckadon (2020)
Positive and significant influence on EA and motivation for EI.	Sri et al. (2021)

Notes: PBL: Problem-Based Learning, IIN: Intrapreneurial Intentions, INC: Innovation Capacity, EA: Entrepreneurial Attitude, EI: Entrepreneurial Intentions, SN: Subjective Norms, PBC: Perceived Behavioral Control, RTC: Risk-Taking Capacity.

**(H6).** Hypothesis 6. University students’ participation in a subject taught using the Problem-Based Learning methodology favors the behavior of the Risk-Taking Capacity concerning their Intrapreneurial Intentions.

Fig. 1 presents the conceptual model proposed for analyzing the behavior of the variables that influence the IIN in a subject taught using the PBL methodology.

### 3. Methodology

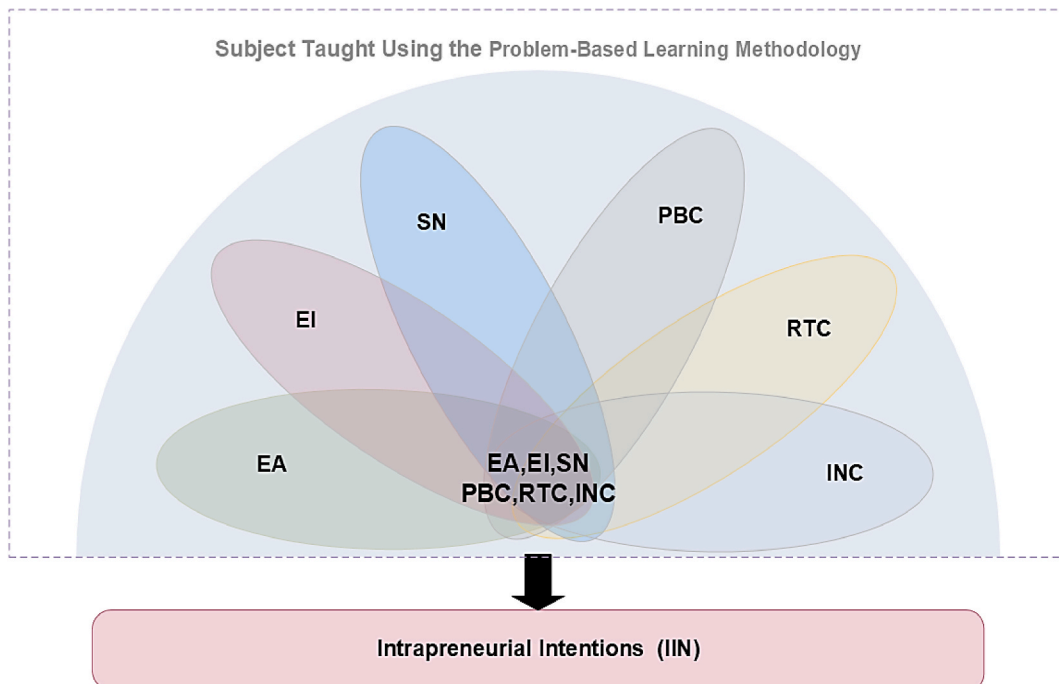
#### 3.1. Problem-based learning applied to a university subject

We focused our research on the students of the Local Development Policy course of the Labor Relations and Human Resources Degree at the University of Seville (Spain). The results analyzed come from a sample collected in two academic years (2020-21 and 2021–22). The topics addressed include theoretical and practical training concerning the elements that make up a microeconomic model of local development of a territory, which includes two specific issues on local entrepreneurship (business education). The class dynamics is made up of two types of differentiated sessions: first, theoretical sessions (30% of the total hours of the course), and second, practical sessions, where students must solve a series of questions about the economic model of development of a municipality (70% of the total hours of the course). In this final report, students must put into practice all the theoretical aspects addressed by designing and implementing an economic development model for a specific territory. The activities developed in the course taught using the PBL methodology are shown in Table 2.

#### 3.2. Data and collection

To study the behavior of the variables with influence on the IIN in the context of a subject taught using the PBL methodology, a quasi-experimental and pre-test-post-test research was designed with a single group and an ad hoc face-to-face survey. At the beginning and the end of the course, the teachers explained to the students the most relevant features of PBL methodology and the convenience of collecting data to determine their impact on the IIN. The students were always involved in this research as a key to improving teaching. After the students’ approval to participate, the paper questionnaire was distributed. Students had 30 min to complete it (both times). In addition, the teachers resolved any doubts about the form, its use, and data processing.

Each survey was identified with a nominative registration number and used both times. Anonymity was always maintained, and traceability of the process was guaranteed. Only those surveys completed twice by the same person were included in the study; obtaining only the survey from one point (initial or final) was not included.



**Fig. 1.** Conceptual model

Notes: IIN: Intrapreneurial Intentions, EA: Entrepreneurial Attitude, EI: Entrepreneurial Intentions, SN: Subjective Norms PBC: Perceived Behavioral Control, RTC: Risk-Taking Capacity, INC: Innovation Capacity.

Source: own elaboration

**Table 2**  
Summary of activities in the Local Development Policy subject using the PBL methodology.

Phase	Activities
Problem Presentation.	Formulation of concrete problems about a municipality by teachers. Problems are presented as unknowns and deal with the subject's content.
Doubts and questions about the formulated problems.	The teacher resolves doubts for the students. (Supervision fosters a collaborative attitude to identify the most effective solution to the problems of each municipality).
Planning Task	The students (in working groups of five to six people) are self-taught in the characteristics of the selected territory (from a brief guideline of the teachers), building possible solutions to the problems formulated. Tasks carried out in this phase: 1) Processing the information collected from the city council's web page. 2) Proposing solutions to the questions/problems formulated. 3) Combining all the answers to elaborate the final report.
Outcome and Evaluation of the process.	Outcome: Response to the problem posed, with students developing their proposals. - Presentation of a final report with all the answers to the questions. The teacher evaluates this report. Evaluation of the process: Students evaluate their knowledge of the subject and share in the community how they are experiencing the methodology followed. - The teacher uses different resources (speeches by experts and former students, answers from other territories) to confirm cases related to classroom dynamics.
Restart the work circle with new questions (if necessary) and conclusions.	After the evaluation, the teacher determines if it is necessary to start the process again. Teacher's confirmation of how the PBL students have worked: 1) PBC putting into practice the knowledge of business creation. 2) EA, SN, and EI experience the proposals' territorial and personal benefits and impacts in their person. 3) RTC and INC solve the problems posed by looking for solutions that imply reaching the maximum qualification for the job.

Notes: PBL: Problem-Based Learning, PBC: Perceived Behavioral Control, EA: Entrepreneurial Attitude, EI: Entrepreneurial Intention, RTC: Risk-Taking Capacity, INC: Innovation Capacity SN: Norma subjective.

**Table 3**  
Logistic regression model variables.

Independent variables	Construct Composition	Acronym
Subjective Norms (Likert scale 1-5)	How do you value entrepreneurial activity among your family members? How do you rate entrepreneurial activities among your closest friends? How do you rate entrepreneurial activities among your classmates? If you decided to create a company, how would your family value this fact? If you decided to create a company, how would your closest friends value that fact? If you decided to create a company, how would your classmates value that fact?	SN
Attitude Towards Entrepreneurship (Likert scale 1-5)	Being an entrepreneur has more advantages than disadvantages. Being an entrepreneur is attractive to me. If I had the opportunity and the means, I would like to start my own company. Becoming an entrepreneur would be something I would be delighted with. Out of several options, I would prefer to be an entrepreneur.	EA
Perceived Behavioral Control (Likert scale 1-5)	Starting a business and keeping it running would be easy for me. I can start a viable business. I can control the process of setting up a new business. I know the practical details necessary to start a business. I know how to develop a business project. If I were to start a business, I would have a good chance of success.	PBC
Entrepreneurial Intention (Likert scale 1-5)	I am prepared to do what it takes to become an entrepreneur. My career goal is to become an entrepreneur. I will make every effort to start and continue my own business. I am determined to start a business in the future. I am considering starting my own business.	EI
Innovative Capacity (Likert scale 1-7)	I would generate new, valuable ideas within the company. I would develop new processes, services, or products. I would innovatively approach my tasks. I would develop new ways of doing things.	INC
Risk-Taking Capacity (Likert scale 1-7)	I would try new things, even if they have a chance of not working out. I would engage in activities that need to be revised. I would take calculated risks despite the possibility of failure.	RTC

**Table 4**  
Omnibus tests on the coefficients of the models.

Model		Chi-Square	gl.	Significance
Initial Moment	Step	296.694	7	0.001
	Block	296.694	7	0.001
	Model	296.694	7	0.001
Final Moment	Step	206.951	7	0.001
	Block	206.951	7	0.001
	Model	206.951	7	0.001

### 3.3. Sample characteristics

We proceeded to an incidental non-probabilistic sampling, where the survey was given to all the people attending, and 267 responses were obtained from 390 people enrolled in the subject. This resulted in a representative sample (less than 5% error at 95% confidence). Furthermore, both the percentage of responses obtained by sex (49.4% men and 50.6% women) and by age (78.3% between 18 and 25 years) are close to those observed in the general university student population in Spain.

### 3.4. Measuring instruments

The measuring instrument of variables was based on two validated scales: Liñán and Chen's (2009) for SN, EA, PBC, and EI, together with González-Serrano et al.'s (2019) for INC and RTC (Table 3).

The IIN was measured using a dichotomous question ("If the company had a department that encouraged the development and management of ideas, products, or services generated by you, what would you prefer: to start your own business or continue to be part of the company as an employee?") At the beginning of the training, 40.45% indicated that they preferred to be part of the company rather than create their own company to carry out their initiative. In comparison, at the end of the training period, the percentage rose to 43.82%. The application of MacDonaldis' Omega (Hayes & Coutts, 2020) determined that the six constructs identified to measure IIN and the variables that indicate it present internal consistency reliability. The results were higher than 0.7 in all cases (0.722 SN, 0.961 EA, 0.851 PBC, 0.963 EI, 0.922 INC, and 0.930 RTC).

### 3.5. Data analysis

The data analysis is twofold: first, to achieve the proposed objectives and second, to contrast the hypotheses using the logistic regression model and fs-QCA technique.

For the logistic regression model, the dependent variable measuring IIN was identified with the following dichotomous question formulated in the instrument: "If the company had a department that encouraged the development and management of ideas, products, or services generated by you, which would you prefer: to start your own business or to continue being part of the company as an employee?" With two answers: 1) I would continue to be part of the company = Intrapreneurial person, and 2) I would still set up my own business = Entrepreneurial person. Six independent variables were used and are presented in Table 3. A logistic regression model was proposed, considering a particular case of discriminant analysis (Wooldridge, 2010) that allows us to determine the weights of the elements that influence the probability that a university person identifies as an intrapreneur.

After performing the logistic regression analysis, incorporating a qualitative study using the fs-QCA technique was particularly interesting. This technique made possible a combined analysis of variables of different types (by calibrating them) while allowing the

**Table 5**  
Classification table.

Moments	Suppose the company had a department that encouraged you to develop and manage the ideas, products, or services you generated. Would you prefer to start your own business or continue to be part of the company as an employee?	Forecast group		Correct Percentage
		Start your own business.	To develop the product or service within the company	
Initial Moment	Start your own business	159	0	100%
	To develop the product or service within the company	8	100	92.6%
Final Moment	Start your own business	146	4	Global Percentage 97% 97.3%
	To develop the product or service within the company	12	105	89.7%
				Global Percentage 94%

**Table 6**  
Results of the binary logistic regression analysis initial moment.

Variables	B (coefficient)	E.T.	Wald	gl.	p-value	(Odds ratio)
SN	6.615	1.697	15.197	1	0.000	746.280
EA	-9.062	2.219	16.678	1	0.000	0.000
PBC	4.061	1.648	6.076	1	0.014	58.056
EI	-4.623	1.605	8.295	1	0.004	0.010
INC	5.438	1.534	12.563	1	0.000	230.076
RTC	-6.292	1.891	11.067	1	0.001	0.002
Constant	19.948	5.747	12.046	1	0.001	460.603.713.962
The logarithm of the likelihood -2						63.645
Cox and Snell R-square						0.671
R square of Nagelkerke						0.906

Notes: EA: Entrepreneurial Attitude, EI: Entrepreneurial Intentions, SN: Subjective Norms PBC: Perceived Behavioral Control, RTC: Risk-Taking Capacity, INC: Innovation Capacity.

**Table 7**  
Results of the binary logistic regression analysis final moment.

Variables	B (coefficient)	E.T.	Wald	gl.	p-value	(Odds ratio)
SN	2.777	0.710	15.284	1	0.000	16.068
EA	-1.295	0.584	4.911	1	0.027	0.274
PBC	3.264	0.814	16.102	1	0.000	26.163
EI	-2.885	0.726	15.796	1	0.000	0.056
INC	-2.653	0.714	13.789	1	0.000	0.070
RTC	0.906	0.412	4.835	1	0.028	2.473
Constant	4.570	2.293	3.973	1	0.046	96.542
The logarithm of the likelihood -2						159.100
Cox and Snell R-square						0.539
R square of Nagelkerke						0.723

Notes: EA: Entrepreneurial Attitude, EI: Entrepreneurial Intentions, SN: Subjective Norms PBC: Perceived Behavioral Control, RTC: Risk-Taking Capacity, INC: Innovation Capacity.

integration of quantitative and qualitative variables. The *fs*-QCA technique provides a configuration determined by an observed derivative or a derivative considered to be of interest (Pappas & Woodside, 2021). The QCA analysis model comes in three variants: crisp-set QCA (csQCA), multiple-valued QCA (mvQCA), and fuzzy-set QCA (*fs*-QCA). QCA (*fs*-QCA) was used as a model based on qualitative comparative analysis (QCA), grounded on Boolean logic and combinatorics. They prioritize combining variables or conditions to obtain results (Prado-Gascó & Calabuig-Moreno, 2016).

#### 4. Analysis and results

##### 4.1. Intrapreneurial intention model

A logistic regression model was developed to identify the variables influencing IIN. The Chi-Square test showed significant effects; the introduced variable improved the fit of the initial and final models (Table 4).

Table 5 verifies the model’s predictive capacity. It confirms that the model correctly classifies 97% of the students at the initial moment and 94% at the final moment. These results confirm the excellent fit of the variables to the model.

**Table 8**  
Necessary conditions of the IIN.

	Moment 1		Moment 2	
	IIN		IIN	
	Consistency	Coverage	Consistency	Coverage
INC	0.748679	0.640207	0.353162	0.661331
RTC	0.741698	0.709183	0.443333	0.639108
EI	0.789811	0.786054	<b>0.638803</b>	<b>0.715215</b>
PBC	0.496163	0.645845	0.436923	0.528919
EA	<b>0.893144</b>	<b>0.715523</b>	0.470769	0.728861
SN	0.678365	0.646333	0.371624	0.485051

Notes: EA: Entrepreneurial Attitude, EI: Entrepreneurial Intentions, SN: Subjective Norms PBC: Perceived Behavioral Control, RTC: Risk-Taking Capacity, INC: Innovation Capacity.

In bold are the conditions with higher consistency but not necessary (consistency <0.90).



Table 6 (initial moment model) and Table 7 (final moment model) show the regression coefficients with the corresponding errors (E.T.), the values of the Wald statistic to evaluate the null hypothesis, the associated statistical significance (p-value), and the value of the Odds Ratio with its confidence interval. The models of the initial and final moment present four common variables. In both models, EA and EI negatively influence INI; SN and PBC have a positive impact. Initially, RTC showed a negative relationship and INC a positive one; after the PBL training, these results were reversed. With these six variables, the INI model is configured. Literature shows us the relevance of gender in the studies of EI and IIN, so its significance has been studied. In the analysis of the results at the initial moment, the gender dimension is not significant (its associated p-value is greater than 0.05), and the same does not occur at the final moment, where it is an essential variable with a negative influence ( $B = -2$ ,  $p\text{-value} = 0.002$ ). As the variable has been coded, this result is interpreted as the probability of being an intrapreneur is reduced in the case of women.

These results allow us to construct the equation of the regression model that shows the weights of each component at both times of training:

$$y_{\text{initial moment}} = 19.948 + 6.615_{SN} - 9.062_{EA} + 4.061_{PBC} - 4.623_{EI} + 5.438_{INC} - 6.292_{RTC}$$

$$y_{\text{final moment}} = 4.570 - 2.000_G + 2.777_{SN} - 1.295_{EA} + 3.264_{PBC} - 2.653_{INC} + 0.906_{RTC}$$

#### 4.2. Qualitative analysis

To verify that the variables studied help measure the IIN, an fs-QCA analysis was performed, identifying conditions that are sufficient or necessary to explain a result and those that are insufficient but are essential parts of solutions that can explain the result. To perform QCA analysis using the fuzzy-set technique, we checked the necessary conditions for high levels of IIN and low levels of IIN at time one. The results obtained (Table 8) indicate that more than the conditions separately are needed for the presence of IIN (consistency below 0.9). Without being necessary for the IIN, the conditions with the most significant weight are EA and INC. In the same way, the variables needed for the second moment are calculated, evidencing, in this case, the relevance of EI in the IIN and of SN in the absence of IIN.

Subsequently, the combination of conditions that give rise to high levels of IIN was calculated, as shown in Table 9. Although the sample size is adequate for applying this method when performing the analysis with six variables, the different combinations needed to reach the minimum necessary for using this technique, with a minimum consistency level of 0.8, were reduced to 0.7. The Quine-McCluskey algorithm was used to obtain the final solution. The fs-QCA analysis of the first moment shows the set of sufficient causal configurations, the total and exclusive coverage rate of each configuration, and the totals of the solution. Eng and Woodside (2012) state that an fs-QCA model is informative when the consistency is higher than 0.74. As can be seen in Table 9, two solutions were obtained for the presence or high levels of IIN, which could explain 77% of the cases. The second and most explanatory solution presents a consistency of 0.76, which is very similar to the first.

The configuration reflecting SN, EA, EI, RTC, and INC (Table 9) explains 57% of the cases of high IIN, and almost one-fifth of the cases of high IIN are defined exclusively by this combination. Looking at the results of the parsimonious solution, the IE variable would be critical, although optional, to achieve high levels of IIN.

Table 10 shows the results for the second moment. The first and second solutions are the most consistent, with a value above 0.75. The second and most consistent combination explains 69% of the cases with high IIN, while the four solutions explained 48%.

At the second moment, the critical variable is EA. Thus, a change is observed concerning moment one. Following the results of the fs-QCA analysis of the first and second moments, the EA presents a high consistency at the initial moment without reaching the necessary condition. In contrast, at the final moment, the EI has this consistency. In addition, to achieve a high IIN rate, the combinations presented several attributes at the first moment. In contrast, in the end, EA is the common condition in all the varieties. We can confirm that there has been a change in the conditions for achieving high IIN rates, which may have been promoted by participation in a subject taught with the PBL methodology.

The results derived from the treatment of the data show that the variables presented to measure IIN explain around 70% of the cases. In comparison, the fs-QCA analysis explains 77% and 48% of each of the moments of the study. With all these results, we can conclude that the variables used are appropriate for measuring the IIN.

**Table 9**  
Causal configurations for High IIN at the Initial Moment.

Configuration	Total Coverage Rate	Exclusive Coverage Rate	Consistency Rate
EA*~PBC*EI*RTC*INC	0.41	0.04	0.75
SN*EA*EI*RTC*INC	0.57	0.19	0.76
Overall Consistency of the Solution	0.61		
Global Coverage of the Solution	0.77		

Notes: EA: Entrepreneurial Attitude, EI: Entrepreneurial Intentions, SN: Subjective Norms PBC: Perceived Behavioral Control, RTC: Risk-Taking Capacity, INC: Innovation Capacity.



**Table 10**  
Causal configurations for High IIN at the Final Moment.

Configuration	Total Coverage Rate	Exclusive Coverage Rate	Consistency Rate
EA*~SN	0.38	0.00	0.75
~PBC*EA	0.69	0.03	0.78
~RTC*EI*~PBC	0.34	0.06	0.65
~INC*~RTC*EA	0.31	0.00	0.69
Overall Consistency of the Solution	0.69		
Global Coverage of the Solution	0.48		

Notes: EA: Entrepreneurial Attitude, EI: Entrepreneurial Intentions, SN: Subjective Norms PBC: Perceived Behavioral Control, RTC: Risk-Taking Capacity, INC: Innovation Capacity.

## 5. Discussion

The logistic regression model showed significant results, and the *fs*-QCA analysis supports these results. They point to the suitability of the identified variables for measuring the effect of the PBL on the behavior of the variables that influence the IIN and the relevance of each of them in the suggested effect.

After their study at the two points in time analyzed, the results show how, in general, the teaching of a subject using the PBL methodology affects the behavior of the variables that influence the university IIN (Bjornali & Støren, 2012). According to McDonald et al. (2018), the results evidenced how implementing the PBL methodology positively affects the behavior of PBC, SN, and RTC (RQ1). In the case of PBC, this positive behavior aligns with the recommendations proposed by Lorente-Portillo et al. (2024). These authors point out in their work how applying action-oriented methodologies and realistic approaches, such as PBL, leads to an increase in the levels of PBC and, therefore, according to our results, has a positive effect on the IIN of university students. The improvement of this variable may be motivated by the student's perception of greater control of the situation and potential scenarios (Al Halbusi et al., 2023) thanks to the type of actions and activities derived from this methodology. Something similar occurs for the SN in our study. The participation of students in a subject taught under this methodology confirms what was highlighted by Binkley et al. (2012). They pointed out how the very nature of PBL implies the development of skills by the student aimed at the resolution of real situations through initiatives that, in many cases, are novel and innovative (Lonergan et al., 2022), thus favoring the improvement of the SN of university students and its influence is more significant as a predictor of the intention of a given behavior, as already pointed out by Adelana et al. (2024). Regarding RTC, the results align with previous works in the related literature when addressing the positive effects of the use in the classroom of methodologies such as PBL e.g. (Shipton, 2023). In our work, however, RTC has a surprising behavior concerning what was expected according to previous works, e.g., that of González-Serrano et al. (2019) and that of Galván-Vela and Sánchez-Limón (2018). Initially, the influence exerted by the RTC on the IIN was negative; therefore, it was not very likely to generate intrapreneurial behaviors. However, after the participation of students in a subject taught with the PBL methodology, the RTC becomes a variable that positively influences the IIN, potentially generating intrapreneurial behaviors in a future professional (Gawke et al., 2019). Nevertheless, this change in RTC behavior is consistent with the findings by McDonald et al. (2018) and Santateresa (2016) that evidence improving students' entrepreneurial competencies and the RTC.

Therefore, it is concluded that the hypotheses H2, H3, and H6 are supported. This is based on the positive evolution of the values obtained about the IIN consulted through the question, "If the company had a department that encouraged the development and management of ideas, products, or services generated by you, what would you prefer: to start your own business or to continue being part of the company as an employee?"

Concerning EA and EI (RQ1), although results show a clear improvement from the initial to the final moment, the direction of their influence on the IIN remains negative. Consequently, Hypotheses H1 and H4 are not supported. This result can be interpreted as surprising considering previous work in which they are among the strongest predictors of entrepreneurial behavior in the case of university students, e.g., Lüthje and Franke (2003) and more recently, Amofah and Saladríguez (2022), Kruse (2020), Shah et al. (2020) and Widiastuti et al. (2024). Nevertheless, notwithstanding the predominant tendency of the literature in this direction, it is not free of research that, like ours, points to the non-existence of a positive relationship between these variables and entrepreneurial behaviors, e.g., Zhang et al. (2015) and Siu and Lo (2013). The reasons given and mentioned in these studies could include the lack of professional experience, and in the case of having it, in many cases, not in positions related to their training and qualifications, which means that this experience does not favor a future professional positioning on the part of the student and the other hand, the absence of close references that could positively influence their intention to develop certain types of behaviors such as intrapreneurial behaviors.

Regarding the students' perception of the INC variable (RQ1), this changes its meaning concerning the influence on the IIN, turning from positive (initial moment) to negative (final moment). Thus, hypothesis H5 is not supported. While the change of direction in the evolution they are in the same line as the findings of Bjornali and Støren (2012), who establish the lower innovation orientation of university students in degrees related to business management. In the case of a subject taught through the PBL methodology, students are fully aware of the complexity of the innovation process, becoming aware of their capabilities and everything they need to improve (Chang et al., 2022). This may be because the person optimizes their perception of their INC, as they will feel more capable of identifying and exploiting new business opportunities through their entrepreneurial project (Wathanakom et al., 2020) and not by working for an organization.

Another relevant aspect that emerges from the analysis of the results is that the intention to be intrapreneurial as a function of gender is different (RQ2). Our results align with when they point out that the probability of being intrapreneurial is different according

to gender, being lower for women. This is also an analogy with the other university EI between women and men (Choukir et al., 2019; López-Delgado et al., 2019; Ruiz et al., 2019) and confirms the importance of improving institutional (equality levels) and individual (entrepreneurial skills, networks and detection of business opportunities) also in the case of fostering and enhancing the intrapreneurial intentions of university students.

### 5.1. Theoretical contributions

This research has important implications for theory, as it contributes to advancing knowledge on the influence of PBL methodology on relevant elements of IIN in university students. The result provides empirical evidence that helps to fill gaps in the research on IIN models in university students and which learning and teaching methodologies favor their improvement. Although the case of EI in the university context is a field of study that has grown in recent years, the case of IIN is not the same; thus, as highlighted González-Serrano et al. (2023), research is also needed to analyze the IIN of university students to make further progress in this field.

The main theoretical contribution of this research is the empirical confirmation of the fundamental role played by PBL in the behavior of the variables that influence the levels of IIN of university students. For this purpose, the behavior of each variable concerning the IIN before and after the participation of university students in this subject was measured. In addition, the analysis of the results shows how the involvement of students in a subject taught with this methodology generates different behaviors of the variables that influence IIN according to gender.

On the other hand, in addition to the causal relationships between the elements potentially predictive of IIN, another of the contributions of this work lies in confirming the relevance of each of the elements to produce the desired positive effect on IIN. That is to say, the results of the work establish how the teaching of a subject using the PBL methodology improves the behavior of the elements that favor greater IIN on the part of university students, but it also shows how they should be combined and the relevance of each one of them in the desired effect.

This contribution to theory also represents an advance in science since no works address IIN and active teaching and learning methodologies in a connected way, specifically with PBL.

### 5.2. Implications for practice

The practical implications of this work are significant for those responsible for designing and implementing educational policies in the university context. In recent years, in addition to its fundamental role as a source of knowledge and research, the university as an institution has played an active role in fostering entrepreneurial and intrapreneurial skills and competencies among its students (Stephens, 2020), thus favoring the future employability levels of its graduates (Kansikas & Murphy, 2010). Their educational intervention enhances knowledge acquisition and entrepreneurial traits (Nabi et al., 2017).

The results of this work allow progress to be made in understanding the direct and indirect causes of the potential intrapreneurial behavior of its graduates, thanks to the promotion of intrapreneurial intentions. These results show how teaching a subject through the PBL teaching and learning methodology favors the improvement of the variables that positively influence the IIN of university students. The inclusion of the gender dimension in the analysis of results also shows that in the case of the actions proposed by the university institutions to improve IIN through the PBL methodology, it should be considered that the behavior of the variables that have an influence is different by gender.

Promising lines of action are open for university institutions. They now have valuable information to design actions to achieve their goals aligned and interconnectedly, focusing on students and improving their employability when they graduate. As Gonzalez-Serrano et al. (2018) pointed out, developing such policies at the university level is crucial, as these students will soon move into the labor market. These behaviors will be essential for companies to gain and maintain competitive advantages (Marques et al., 2019).

Other possibilities offered by this approach to intrapreneurial behaviors from university institutions are no less important. It promotes an intrapreneurial educational culture where not only the IIN of university students has a place but also corporate entrepreneurship, teaching intrapreneurship, and academic intrapreneurship are configured as possible realities (Guerrero et al., 2021)

### 5.3. Limitations and future research

This work, like all research, has limitations. The first is related to the size of the sample. Although statistically representative and adequate to establish significant relationships between the variables, it can be considered small given the population of university students. Furthermore, despite this limitation, this work allows future researchers to replicate the model, add their data to those presented in this study, and thus extend the findings. The second limitation relates to the geographical location of the sample. The data were collected from a specific sample of university students at a Spanish university, so caution should be exercised when generalizing the results to other places or countries. Finally, the third limitation is related to the study's cross-sectional nature. This means checking the subsequent materialization of intrapreneurial intentions in real behaviors is impossible.

Future lines of research are directly related to the limitations of this study. Concerning the sample, it should be extended to a more significant number of university students. Furthermore, it would be necessary to replicate this study in other countries to determine similarities or differences (depending on the location) in the intrapreneurial intentions of university students who participate in subjects taught through PBL. Regarding the study's cross-sectional nature, longitudinal studies are needed that address the evolution of these intrapreneurial intentions and how using teaching-learning methodologies such as PBL in university teaching favors the development of true intrapreneurs.

## 6. Conclusions

From the empirical derivations and their discussion, three main conclusions are derived. Firstly, the value of the PBL methodology for acquiring theoretical-practical knowledge, together with the development and reinforcement of competencies increasingly demanded by firms and, therefore, that improve the employability of university students manifested through high levels of IIN. Secondly, university students are predisposed to innovative behaviors but less willing to take risks. This circumstance is reversed after improving their perception of the SN, the EA, and the PBC. Finally, from a gender perspective, the increase in the values of the IIN is lower in the case of being a female university student, which evidences the need for more focused research to identify why men and women exhibit significant differences in their IIN and thus implement measures to increase and equalize the IIN levels of both groups.

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## Authors statement

All authors subscribed below to confirm our participation in equal proportion in the different phases of this manuscript's creativity and development process: Conception and design of the work. Data collection. Data analysis and interpretation. Drafting the article. Critical revision of the article. Final approval of the version to be submitted. In addition, we make public our responsibility for the content of the work submitted for review.

## CRedit authorship contribution statement

**Pedro Baena-Luna:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Investigation, Conceptualization. **Isadora Sánchez-Torné:** Writing – review & editing, Software, Formal analysis, Data curation. **Esther García-Río:** Writing – review & editing, Validation, Software, Resources, Methodology, Formal analysis, Data curation. **Macarena Pérez-Suárez:** Writing – review & editing, Writing – original draft, Validation, Investigation, Conceptualization.

## \Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

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