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Article

Entrepreneurial Intention in Romanian Engineering Students: Expanding the Theory of Planned Behavior

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Abstract: This study analyzes the entrepreneurial intention of Romanian engineering students. We had a sample of 700 students (mean age = 23.14; $SD = 2.92$; 378 males and 322 females) who belonged to three technical universities and completed an online survey between October and December 2023. This research extends the theory of planned behavior (TPB) to explore the factors influencing students' entrepreneurial intentions. In addition to base TPB components, such as attitude, normative and perceived behavioral control factors, we considered curiosity and well-being. Three structural equation models were used, one after the other, through the method of partial least squares (PLS-EM). The results show that attitude, perceived control behavior and curiosity have a positive impact on entrepreneurial intention, whereas subjectivenorms, surprisingly, have a negative impact on it. Psychological well-being expressed through autonomy is not associated with entrepreneurial intention in our sample of students. This article contributes to a better understanding of entrepreneurial intention in engineering students.

Keywords: theory of planned behavior; entrepreneurial intention; curiosity; well-being; autonomy



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1. Introduction

Studying entrepreneurial intention (EI) among engineering students has skyrocketed in the last decade (Arango-Botero et al. 2020; Lingappa et al. 2020; Lungu and Georgescu 2023; Cordero et al. 2023; Lei et al. 2023; Vu et al. 2024). The motivation for this kind of research stems from the idea that studying the engineering attitude and behavior of present and future engineers is very important for the economy, as tech companies bring profit and societal development (Barba-Sánchez and Atienza-Sahuquillo 2018).

Research regarding future engineers' entrepreneurial intention has ranged from associating the intention with personality traits (Şahin et al. 2019; Udayanganie et al. 2019; Al-Ghazali et al. 2022; Antončič and Auer Antončič 2023) to an association with motivational factors (Newman et al. 2019; Barba-Sánchez and Atienza-Sahuquillo 2018; Vu et al. 2024), with entrepreneurial education (Bazkiaei et al. 2020; Overwien et al. 2024) and with the contextual-external environment (Veljkovic et al. 2019; Lingappa et al. 2020; Hossain et al. 2021; Elnadi and Gheith 2021). Some studies (Kautonen et al. 2015; Fellnhofer 2017; Sampene et al. 2023) analyzing the students' entrepreneurial intention rely on the theory of planned behavior (TPB), which was elaborated by Ajzen (1991, 2011). Recent studies suggest that the relative importance of the elements of the TPB can vary significantly in entrepreneurship (Lv et al. 2021). This indicates that the TPB may not adequately account for the dynamics of entrepreneurial intention, necessitating an extension to incorporate additional variables, such as those related to the specific characteristics of an entrepreneur. In this research, we want to analyze the entrepreneurial intentions of engineering students by using the TPB model and by adding curiosity and psychological well-being to explore whether these variables impact the intentions.

1.1. Entrepreneurial Intention and Behavior

As the most significant predictor of entrepreneurial behaviors, entrepreneurial intention is considered to be of great importance in the field of entrepreneurial studies (Duong 2023). Knowing individual intention allows us to understand the motivational factors influencing behavior (Ajzen 1991, 2011). The need to better understand EI helps us grasp the start-up behaviors. Studies have shown that entrepreneurial behavior is influenced directly by behavioral intention (Ajzen 2011). Researchers have proposed various EI definitions. Therefore, we do not have a strict working definition. In this study, we adopt a broad EI definition, which is widely applied in entrepreneurial research literature: the determination that an individual exerts toward engaging in entrepreneurial behavior (Liñán and Chen 2009).

1.2. The Theory of Planned Behavior and Entrepreneurial Intention

The theory of planned behavior (TPB) (Ajzen 1991, 2011) has been applied on a large scale in the analysis of human behavior. The theory holds that attitude, subjective norms and perceived controlled behavior predict an action's intention (Ajzen 1991, 2011). As TPB reveals, attitude is an important psychological emotion, which predicts a person's intention and is determined by their beliefs related to action and result. Entrepreneurial attitude is about the degree to which the individual self-evaluates their orientation toward entrepreneurship (Liñán and Chen 2009). Subjective norms significantly impact people's intentions. They refer to an individual's perception of social pressure to behave in a certain way. In other words, subjective norms are normative beliefs on the way in which significant others evaluate the individual's behavior and motivation. Normative beliefs pertain to the anticipated likelihood that significant persons or groups will either accept or reject a particular activity. For entrepreneurs, social pressure arrives from family, friends and colleagues (Liñán and Chen 2009). Perceived behavioral control is a defining factor for behavioral intention. It refers to the individual's perception regarding their capacity to behave in a certain way. According to Liñán and Chen (2009), this concept is similar to Bandura's (1997) self-efficacy. However, other perspectives underline the difference between perceived behavioral control and self-efficacy: the first construct includes the feeling of being capable, as well as the perception over one's behavioral control (Ajzen 2002). Ajzen's (1991, 2011) model supposes that the three variables directly impact the intention to behave in a certain way, as if demographics and education do not directly impact the individual's intentions (Ajzen 1991).

Studies that have applied the theory of planned behavior to students' entrepreneurial intentions have explored the aforementioned three key factors (Kautonen et al. 2015; Fellnhöfer 2017; Gorgievski et al. 2018; Dodescu et al. 2019; Elnadi and Gheith 2021; Villanueva-Flores et al. 2023; Tran et al. 2024). For example, researchers have examined the mode in which individual attitude influences the intention of IT professionals to start a business (Lee et al. 2011). Another research work on business students demonstrated that the attitude toward entrepreneurship, subjective norms, perceived behavioral control, as well as entrepreneurship education directly influences the entrepreneurship intention (Sampene et al. 2023). In terms of the subjective norm, researchers have shown that it is an essential factor in influencing the entrepreneurial intention of students (Maheshwari and Kha 2022; Siu and Lo 2013). The literature presents a nuanced view, indicating that subjective norms can have both positive and negative impacts on entrepreneurial intentions depending on various contextual factors. Much of the research has found that subjective norms have a positive impact on entrepreneurial intention (Joensuu-Salo et al. 2021), while other investigations have shown that norms do not correlate with entrepreneurial intention (do Nascimento Silva et al. 2022) or that they have a negative influence on it (Santos and Liguori 2019; Sarwar et al. 2023). For example, Kurjono et al. (2022) highlight that significant subjective norms can either enhance or diminish entrepreneurial intentions based on the social pressures exerted by close relationships, such as family and friends. According to Sarwar et al. (2023), there is a negative correlation between neuroticism and

both entrepreneurial intentions and subjective norms. This suggests that those with greater levels of neuroticism may view subjective norms as obstacles rather than as supports.

It is also worth noticing a variation in effectively applying the theory: the three key factors are examined together or separately. Given a specific context, researchers selectively use different key factors to build up their models (Siu and Lo 2013).

1.3. Entrepreneurial Intention and Curiosity

Curiosity is conceptualized as recognizing the new and grasping the sense it has to offer (Kashdan 2013). Curiosity motivates risk-assuming behavior and helps extracting and assimilating knowledge and meaning from new experiences (Kashdan 2013; Kashdan et al. 2020). Studies on curiosity and entrepreneurship are relatively rare, as there is no ample proof of the role of curiosity in entrepreneurship (Heinemann et al. 2022). This situation motivates the need for more studies, as curiosity is linked to creativity. They both play essential roles, inspire new solutions to existing challenges, (Raine and Pandya 2019; Leick et al. 2023) and positively impact entrepreneurial innovation (Peljko and Antončič 2022b). Entrepreneurial curiosity related to cognition and incertitude is the cause of entrepreneurial success (Arikan et al. 2020). Curiosity motivates entrepreneurs to explore new territories and to question the status quo, as its pairing with creativity leads to a culture of business innovation (Zampetakis 2024). The literature underlines that entrepreneurial curiosity, as opposed to entrepreneurial alertness, is the one factor kickstarting the creation of opportunity (Harrison and Dossinger 2017; Heinemann et al. 2022). Studies suggest that general curiosity can be one of the most important indicators of personality, which determines the entrepreneurial intentions and orientations. For instance, in a sample of 296 participants (entrepreneurs and non-entrepreneurs), researchers proved that curiosity has a powerful epistemic impact on entrepreneurial outcomes. The impact is greater than that of the openness to experience trait in predicting entrepreneurship (Heinemann et al. 2022). Zampetakis' (2024) study on Greek entrepreneurs proved that general curiosity acts as a catalyst for creativity, especially when entrepreneurs lack a tendency for their creativity level to be persistent. Syed et al. (2020) observed that curiosity moderated the relation between entrepreneurial passion and intention. The authors showed the existence of an outcome of moderating innovation between passion and intention. This effect is more intense in individuals with high curiosity than in those with lower curiosity. Other studies show that, in the case of Serbia and Slovenia, entrepreneurial curiosity can act as a good baseline for entrepreneurial innovation, which decisively contributes to business growth (personnel, sales and market value) (Peljko and Antončič 2022a).

1.4. Entrepreneurial Intention and Psychological Well-Being

Psychological well-being (PWB) is described by Ryff and Singer (1996) as a six-fold construct that includes self-acceptance, positive relationships with other people, autonomy, environmental mastery, purpose of life and personal growth. In a meta-analysis of 18,853 people, PWB predicted activity performance and showcased that employees with strong PWB are more productive than their low-scoring PWB colleagues (Salgado and Moscoso 2022). Empirically, studies document both higher and lower levels of well-being among entrepreneurs compared to employees (Stephan et al. 2020).

A series of studies have identified psychological capital (a concept that includes self-efficacy, optimism, hope, resilience) as a significant predictor of EI, suggesting that individuals with high psychological capital are much more likely to translate intentions into actual entrepreneurial actions (Margaça et al. 2021; Liu et al. 2022). On other coordinates, another dimension of PWB addressed in studies that analyzed entrepreneurship was environmental mastery. Through the development of competencies that improve environmental mastery, Lv et al. (2021) addressed how entrepreneurship education can impact entrepreneurial intention. Educational programs can encourage a sense of control over students' entrepreneurial surroundings by providing them with the required knowledge and abilities, which will support both personal development and entrepreneurial ambitions.

Research has shown that the dimension of psychological well-being most related to entrepreneurship is autonomy (Zhang et al. 2015; Stephan et al. 2022). The scientific literature suggests that entrepreneurs experience PWB in a greater proportion than employees because of the greater autonomy and independence that entrepreneurship offers (Shir et al. 2019). As Ryan and Deci (2000) explain in the theory of self-determination, autonomy is an important PWB resource because it allows individuals to choose upon self-determination and to engage in self-regulating actions that satisfy basic psychological needs. In comparison to employees, entrepreneurs can project their business and the work that they do in correlation with their abilities and values. This aspect points to the continuous work autonomy they have: they can choose how, with whom and when to work (Stephan et al. 2022). High autonomy levels indicate that entrepreneurs go through an intense feeling of responsibility for aspects of their work and find their work more meaningful, as they identify with it (Stephan et al. 2020). In comparison to employees, being an entrepreneur is more satisfying and implies more positive experiences and feelings of flourishing determined by autonomy (Stephan et al. 2020; Tahar et al. 2023). Lastly, entrepreneurs' personalities predispose them to handle autonomy and intense and uncertain work (Baron et al. 2016; Mickiewicz et al. 2021). In a sample of 1000 participants, Contreras-Barraza et al. (2022) found that PWB indirectly impacts entrepreneurial intention mediated by the subjective norm. In the case of students, it has been shown that well-being has an indirect effect on entrepreneurial intention mediated by the subjective norm (Contreras-Barraza et al. 2022). At the same time, studies have shown that entrepreneurial intention is developed by courses that emphasize increasing the support of autonomy and curiosity (Puerta-Sierra and Puente-Díaz 2023).

2. Materials and Methods

2.1. Participants and Procedure

The sample for this study included students from three comprehensive Romanian technical universities: The National University of Science and Technology "Politehnica" Bucharest, The Technical University of Constructions Bucharest and The Polytechnic University of Timișoara. The study relied on a cross-sectional design in which students filled in an online survey between October and December 2023. The authors of the study were directly involved in the data collection process. The instruments were accessed via Google Forms® link and were shared during teaching hours. The instruments are part of a more extensive study regarding entrepreneurship in technical universities. The total filling-in time was 14–15 min. The link was secure and could be filled in only once. We introduced the survey by making information clear to the participants: they were informed about the research objective and the procedure, and we requested their informed consent. Participation was anonymous to control social desirability, and withdrawal was permitted at any stage of the process.

According to Soper (2020), we computed the sample sizes using the following parameters: 36 observable variables, 7 latent variables, a probability level of 0.05, an expected effect size of 0.30 and a desired statistical power level of 0.95. A minimum sample size of 247 respondents was recommended. Data were gathered from 700 students.

2.2. Ethical Considerations

The study was conducted in full accordance with ethical principles, including the World Medical Association guidelines from 1975, as revised in 2013. Informed consent was obtained from all participants involved in the study. This study acquired ethical approval from the relevant departmental ethics committee from the National University of Science and Technology Politehnica Bucharest (Reg. No. 3048/16.10.2023).

2.3. Measures

1. *Individual Entrepreneurial Intent Scale—IEIS* (Thompson 2009) measures entrepreneurial intention with the help of 10 items. Three items are reversed, while four are distractor

items unrelated to entrepreneurial intention. Thus, the actual instrument boils down to a number of 6 items. The summing up score leads to results regarding entrepreneurial intention. The sample item is “Intend to set up a company in the future”. We assessed items on a continuum from 1 (definitely not true) to 6 (definitely true). The scale was validated on samples of international and postgraduate students and had a Cronbach α coefficient between 0.84 and 0.91. In our study, the scale showed good factorial validity: $\chi^2/df = 1.39$; CFI = 0.998; TLI = 0.996; RMSEA = 0.024 [0.000–0.060]; SRMR = 0.013.

2. *Entrepreneurial Intention Questionnaire*—EIQ (Liñán and Chen 2009) evaluates EI and the three motivational factors proposed by the TPB. In our study, we only selected items that pertained to motivational factors: attitudes toward entrepreneurship (e.g., Being an internet entrepreneur implies more advantages than disadvantages to me); subjective norms (e.g., If you decided to create a firm, would people in your close environment approve of that decision? a—Your close family, b—Your friends, c—Your colleagues); perceived behavioral control (e.g., I can control the creation process of a new online firm). The items are evaluated on a scale from 1 (total disagreement) to 7 (total agreement). The instrument illustrated good factorial validity in the present study: $\chi^2/df = 1.47$; CFI = 0.995; TLI = 0.995; RMSEA = 0.039 [0.025–0.051]; SRMR = 0.061.
3. *Curiosity and Exploration Inventory-II*—CEI-II (Kashdan et al. 2009) contains ten items with short formulations assessed on a scale from 1 (very little or not at all) to 5 (to the highest extent). It is structured around two subscales: *Stretching* or exploration—the motivation to look for knowledge and new experiences (e.g., I actively seek as much information as I can in new situations) and *Embracing*—the willingness to embrace newness, uncertainty and the unpredictable nature of day-to-day life (e.g., I am the type of person who really enjoys the uncertainty of everyday life). The Cronbach alpha indices reported by the authors in the three studies on inventory validation vary from 0.83 to 0.85 for the total score of the two subscales (total CEI score) (Kashdan et al. 2009). In the present study, we obtained good factorial ratings: $\chi^2/df = 4.82$; TLI = 0.955; CFI = 0.968; RMSEA = 0.065 [0.055–0.076]; SRMR = 0.031.
4. *The Autonomy Scale* extracted from *Short Psychological Well-Being*—SPWB (Ryff and Singer 1996) involves the feeling of independence and self-determination, as well as the ability to think and act in various ways. The scale has three items, one of which is reversed. The items are assessed on a scale from 1 (*strongly disagree*) to 6 (*strongly agree*) (e.g., I believe in my own opinions even if they differ from others).
5. We used a self-reporting questionnaire to collect sociodemographic information, including gender, age, current year of study and the technical subdomain the student is currently studying.

2.4. Hypothesis

H1. *TPB components, attitudes, subjective norms and perceived behavioral control are related to entrepreneurial intention.*

H2. *Curiosity is positively associated with entrepreneurial intention in the presence of norms, attitudes and perceived behavioral control.*

H3. *PWB caused by autonomy is positively associated with entrepreneurial intention in the presence of norms, attitudes and perceived behavioral control.*

2.5. Data Analysis

For data analysis, we used the PLS-SEM method. First, we measured structural model characteristics: Cronbach alpha reliability, convergent validity via the average variance extracted (AVE) and the discriminant via the high-sensibility heterotrait–monotrait (HTMT)

criterion. As a general rule, the Cronbach alpha should score between >0.6 and <1 to obtain an acceptable level of reliability (Pallant 2011); the AVE should score at least 0.50; and the HTMT scores well when below 0.90 or even below 0.85 (Henseler 2020). Another marker used to verify model accuracy is the standardized root mean square residual (SRMR), which, according to recommendations, is adequate when scoring close to 0.080 (Henseler et al. 2016). The analysis of multicollinearity was measured by using the variance inflation factor (VIF) indicator, which must not score above 5.00 (Hair et al. 2019). We used the 5000-sample bootstrapping technique, as Henseler et al. (2016) recommend. We analyzed data using the SPSSv24 (IBM, New York, NY, USA) and ADANCO 2.4.0 (University of Twente, Enschede, The Netherlands) software.

3. Results

3.1. Sociodemographic Characteristics of the Sample

The sample contained 700 students ($M = 23.14$; $SD = 2.92$), of whom 378 were male, and 322 were female. Of the students included, 61.15% were in the first two years of their university studies, while 38.85% were in the final years of their studies. The students' specialization breakdown was as follows: 25.71% in IT, 22.85% in medical engineering, 22.14% in civil engineering, 18.57% in business engineering and entrepreneurship, 5.14% in vehicle engineering, 2.57% in materials engineering, 2.14% in electric engineering and 1.17% in mechanical engineering. Students were enrolled as follows: 51.42% at the "Politehnica" Bucharest, 26.42% at the Technical University of Constructions Bucharest and 22.14% at The Polytechnic University in Timișoara.

3.2. Analyzing Structural Equation Models

We tested three models and evaluated their validity: 1. The base TPB model that predicts that attitude, subjective norms and perceived behavioral control are positively associated with entrepreneurial intention; 2. The model to which we added curiosity; 3. The model to which we added autonomy as a dimension of PWB. Table 1 summarizes the data for all three models. Analysis of the evaluation indicators reveals that all variables and α Cronbach values scored high (>0.80), with the exception of autonomy. However, it scored above the minimum of 0.60 suggested by Pallant (2011). On the other hand, all other variables' α score was between 0.81 and 0.92. AVE (>0.50), and the factor loading of ≥ 0.59 (between 0.59 and 0.93) confirmed the convergent model's validity. HTMT values landed under 0.85 (ranging from 0.20 to 0.77), which proved a sufficient discriminant validity of our obtained models. The VIF scored below 5.00, while the SRMR ranged between 0.0576 and 0.0686. This showcased a sufficient fitness of our models.

Table 1. Evaluation indicators for the three models (reliability, convergent and discriminant validity).

Variables	α	Loadings (Interval)	VIF (Interval)	AVE	1	2	3	4
1. AT	0.92	0.75–0.93	1.79–4.39	0.77				
2. SN	0.81	0.83–0.88	1.66–2.25	0.73	0.55			
3. EI	0.83	0.66–0.82	1.49–2.06	0.55	0.77	0.29		
4. PBC	0.90	0.81–0.92	1.97–3.70	0.77	0.46	0.37	0.81	
5. CZ	0.88	0.59–0.83	1.39–2.55	0.51	0.47	0.46	0.48	
6. AU	0.60	0.66–0.82	1.06–1.34	0.52	0.36	0.47	0.29	0.35

Note: AT—Attitudes; SN—Subjective norms; EI—Entrepreneurial intention; PBC—Perceived behavioral control; CZ—Curiosity; AU—Autonomy. On the diagonal (in bold) the HTMT values.

Measurement of Structural Models

As can be seen in Figure 1, the three elements involved in TPB impact entrepreneurial intention, albeit in various ways. The attitudes and perceived behavior positively influence EI ($\beta = 0.45$; $t = 12.64$, and $\beta = 0.43$; $t = 13.30$; $p < 0.001$, respectively), while subjective norms negatively impact EI, yet to a lesser extent ($\beta = -0.09$; $p < 0.001$) (Table 2). For the

base model, the R^2 (explicit variance) scores 0.613 and is considered to be a high statistical score (Marcoulides et al. 2009). Thus, Hypothesis 1 is confirmed.

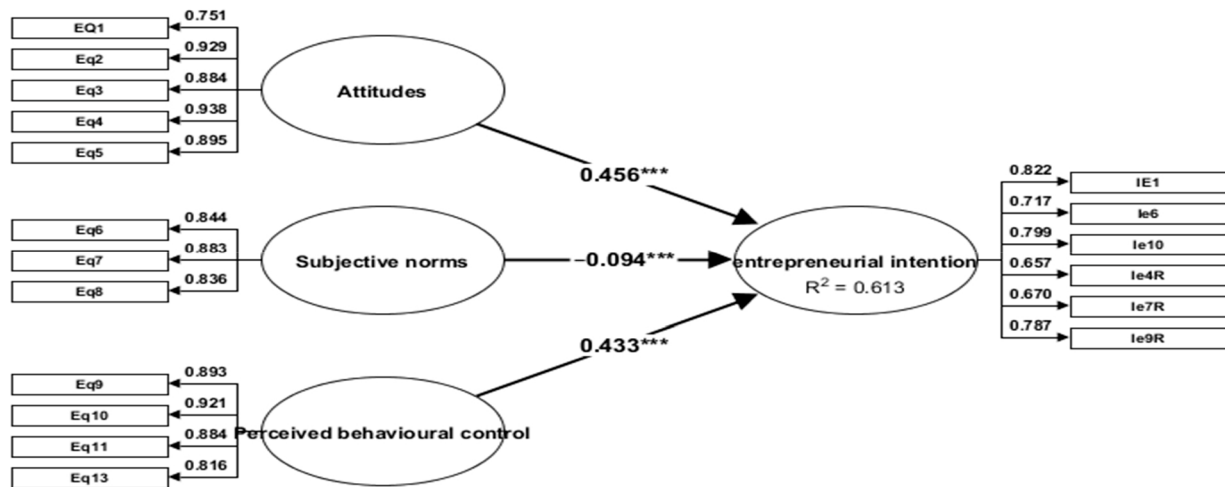


Figure 1. Base model, according to TPB. Note: All path coefficients (β) are significant at *** $p < 0.001$.

Table 2. Total effect inferences (TPB base model).

Constructs	β	SE	T	p
Attitudes \rightarrow EI	0.45	0.03	12.64	0.000
Subjective norms \rightarrow EI	−0.09	0.02	−3.31	0.001
Perceived behavioral control \rightarrow EI	0.43	0.03	13.30	0.000

Note: EI—Entrepreneurial intention.

Next, we added curiosity to the base model. The results are presented in Figure 2. We observed that attitude ($\beta = 0.44$; $t = 12.35$), controlled behavior ($\beta = 0.40$; $t = 12.53$) and curiosity ($\beta = 0.10$; $t = 3.77$) have a significant positive importance over entrepreneurial intention, while subjective norms have a negative impact ($\beta = -0.12$; $t = -4.19$) (all at $p < 0.001$) (Table 3). The R^2 score is slightly better, at 0.621. Hypothesis 2 is confirmed.

Table 3. Total effect inferences (Model 2).

Constructs	β	SE	T	p
Attitudes \rightarrow EI	0.44	0.03	12.35	0.000
Subjective norms \rightarrow EI	−0.12	0.02	−4.19	0.000
Perceived behavioral control \rightarrow EI	0.40	0.03	12.53	0.000
Curiosity \rightarrow EI	0.10	0.02	3.77	0.000

In the third version, we replaced curiosity with PWB. The result is similar to the first two models, in which attitude and controlled behavior have a positive impact ($\beta = 0.45$; $t = 12.55$, respectively; $\beta = 0.43$; $t = 13.34$; $p < 0.001$), while norms negatively impact EI ($\beta = 0.09$; $t = -3.41$; $p < 0.001$). PWB expressed through autonomy fails to prove a significant influence over EI ($\beta = 0.010$; $p = 0.681$) (Table 4). The R^2 scores 0.614 (Figure 3). Hypothesis 3 regarding the relation between autonomy and EI is not supported by our result.

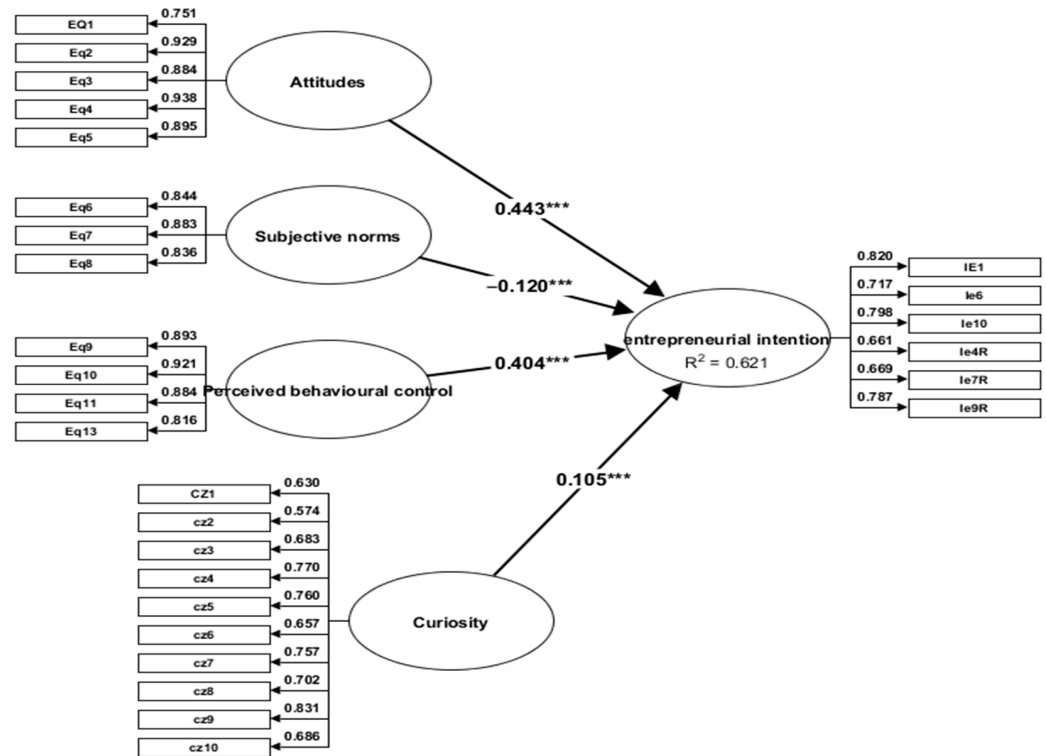


Figure 2. Entrepreneurial intention and curiosity. Note: All path coefficients (β) are significant at *** $p < 0.001$.

Table 4. Total effect inferences (Model 3).

Constructs	β	SE	t	p
Attitudes → EI	0.45	0.03	12.55	0.000
Subjective norms → EI	−0.09	0.02	−3.41	0.000
Perceived behavioral control → EI	0.43	0.03	13.34	0.000
Well-being (Autonomy) → EI	0.01	0.02	0.41	0.681

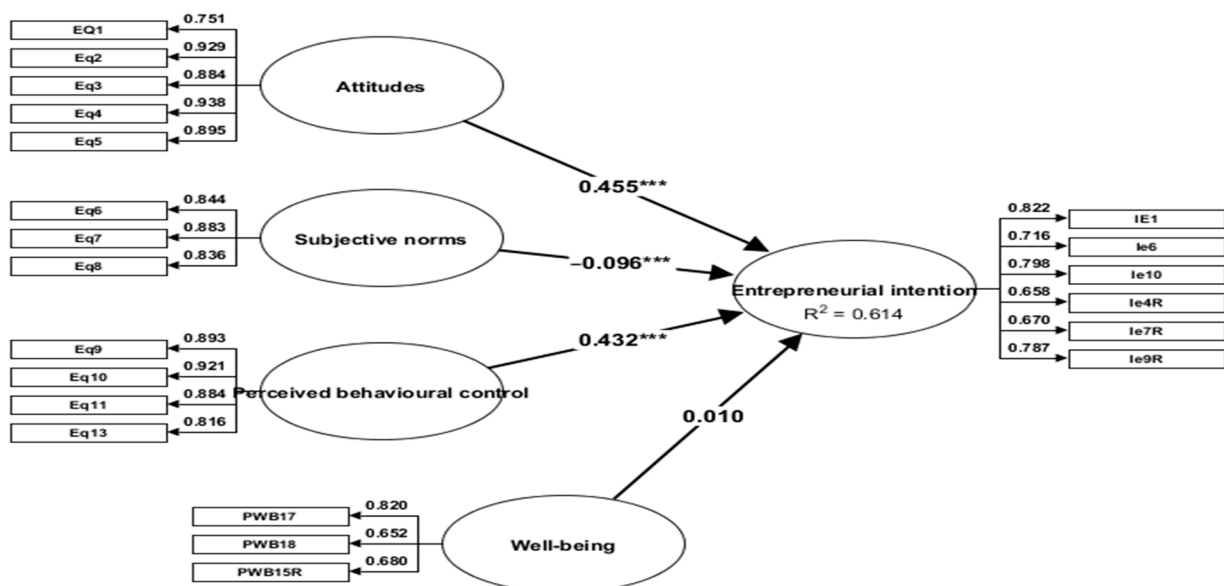


Figure 3. Entrepreneurial intention and PWB. Note: All path coefficients (β) are significant at *** $p < 0.001$.

4. Discussion and Conclusions

Our study used TPB, which focuses on attitudes, subjective norms and perceived controlled behavior, to investigate EI in engineering students. In addition, we added two other possible context determinants: curiosity and psychological well-being. Consistent with previous research that applied TPB in the study of entrepreneurship (Siu and Lo 2013; Blanco-Mesa et al. 2023; Tran et al. 2024), we found support for the relationship between entrepreneurial intention on the one hand and attitudes oriented toward entrepreneurship and perceived behavioral control on the other hand. Both determinants highly impact intention; yet, attitudes register the highest impact ($\beta = 0.45$ in the first and third models, $\beta = 0.44$ in the second model; $p < 0.001$), thus suggesting that they are the main factor in EI. This means that the students predisposed to forming the intention to open businesses are those who have a positive perception of becoming an entrepreneur. In fact, Ajzen (1991) stresses that attitude becomes the most important determinant of the three in predicting intention in any behavior. As studies show (Su et al. 2021; Talukder et al. 2024), attitudes oriented toward entrepreneurship are formed by entrepreneurial education. Many studies showcased that perceived university support via courses and training programs significantly affects the students' attitude regarding entrepreneurship. This showed the critical role that universities have in establishing the entrepreneurial spirit in students (Barba-Sánchez and Atienza-Sahuquillo 2018; Su et al. 2021; Ripolles and Blesa 2023; Sampene et al. 2023). Also, Krishnawati et al. (2023) proved that entrepreneurial education can contribute significantly to the emotional competencies as well as to the cognitive competencies involved in entrepreneurship. These are directly linked to attitudes, interests and entrepreneurial self-efficiency. Although the entrepreneurial education value was not taken into consideration, it is highly likely that education impacts the students' attitudes. This idea is confirmed by the fact that most of the analyzed students followed training programs such as "Be an Entrepreneur 8.0" existing within "Politehnica" Bucharest, while another segment of the students came from the faculty of business engineering and entrepreneurship.

Perceived behavioral control is the second determinant of EI in all three models ($\beta = 0.43$ in the first and third models, $\beta = 0.40$ in the second model; $p < 0.001$). It reflects an evaluation of resources that the individual has. It seems that students are aware of their knowledge and capacities. The result is in agreement with previous research reporting that PBC mainly determines EI (Kautonen et al. 2015; Laguía et al. 2017; Mahlaole and Malebana 2021). Curiosity is another determinant of EI ($\beta = 0.10$; $p < 0.001$). Students are open to new experiences and are interested in entrepreneurship despite uncertain data coming from the business world.

Surprisingly, subjective norms negatively impact EI, though not to a great extent. This means that the higher the level of social pressure, the less students will intend to become entrepreneurs. The result contradicts studies that considered the influence of subjective norms on EI (Siu and Lo 2013; Kautonen et al. 2015; Joensuu-Salo et al. 2021). For instance, a relatively recent study evaluating EI in three east European countries (Romania, Bulgaria and Serbia) showed that family support greatly impacts the students' EI. Students acknowledging the support of close relatives and parents are more willing to involve themselves in entrepreneurial activities (Veličković et al. 2023). Thus, controversy occurs. In addition, other authors found that subjective norms are insignificant for EI (Arango-Botero et al. 2020; do Nascimento Silva et al. 2022), as they have no direct impact (Talukder et al. 2024; Tran et al. 2024) or provide a negligible contribution ($\beta = 0.09$) (Joensuu-Salo et al. 2015).

Our result suggests that the social environment (family, friends and colleagues) is not perceived by analyzed students as being supportive of starting a business. It is possible that the general economic situation of a country impacts how people think about entrepreneurship, bringing financial satisfaction and the idea of bankruptcy. In this case, analyses on the impact of subjective norms on EI must take cultural influences into consideration. In some cultures, entrepreneurship is risky and unsafe; therefore, the subjective norms of that culture can discourage EI. Begley and Tan (2001) argue that subjective norms tend to play a

more powerful role in explaining intention in collectivist cultures, as well as a weaker role in individualistic societies. [Andrade and Carvalho \(2023\)](#) proved in a systematic literature study based on geographic regions that subjective norms have a lower impact on EI in Europe than in Africa, where social pressure is at its most visible in relation to getting involved in entrepreneurial activities. In individualistic societies, such as those found in many Western countries, knowing an entrepreneur can significantly enhance entrepreneurial intentions, as personal attitudes become stronger predictors of intentions. This suggests that subjective norms in individualistic contexts are often shaped by individual aspirations and the desire for personal achievement rather than collective expectations ([Schmutzler et al. 2019](#)). In collectivist cultures, such as those prevalent in many African societies, the influence of subjective norms is significantly stronger. Collectivist cultures emphasize group cohesion, social harmony and the importance of community. As a result, the expectations and behaviors of family, friends and community members play a crucial role in shaping entrepreneurial intentions ([Pham et al. 2023](#)). On the other hand, we must not forget that [Ajzen's \(2002\)](#) subjective norms refer to family, friends and colleagues. Yet, it is possible that other factors are normative and influence EI ([Liñán and Chen 2009](#)). We must also look at a comparative analysis specific to engineering students and other categories.

The result regarding the insignificant relation between autonomy and EI is rather surprising. It is possible that the explanation is related to a moderate level of autonomy of the students. On the other hand, [Zhang et al. \(2015\)](#) found in a research work on business school students that PWB is negatively associated with EI. The authors' explanation consists of the fact that students who are less positive and less self-determined are less confident in finding a job, and starting a business appears to be more attractive to them ([Zhang et al. 2015](#)). On the other hand, some studies indicate that while autonomy is correlated with entrepreneurial intention, it may not serve as a strong predictor of such intentions ([Yukongdi and Lopa 2017](#)). This highlights the complexity of the relationship, suggesting that while autonomy is an essential factor, it interacts with other variables, such as individual motivations and contextual factors.

Some limits in applying PWB variables are determined by focusing the research on autonomy alone. Thus, our further studies should explore the impact of all six PWB dimensions on students' EI, and they should also use other PWB evaluation instruments. Another limitation of this study is that the sample contains a large number of freshman students. Further research should also consider master's students who work and have work experience. We must not lose track of the fact that we used self-reporting scales that do not allow the generalization of the results, and this can lead to bias. The cross-sectional methodology of this study means that the results should be read carefully, and they should be confirmed by qualitative research including students in a variety of contexts and disciplines.

In conclusion, the attitude toward entrepreneurship, curiosity, which motivates risky behavior, and the belief in having the necessary internal resources motivate students to engage in entrepreneurial activities. At the same time, they are aware of social obstacles. In these conditions, we expect that university entrepreneurial education programs will stimulate student EI by generating positive attitudes, developing curiosity and cultivating self-trust. The European Commission's EntreComp framework maintains that the entrepreneurial skills that must be developed are autonomy, social skills, creativity, curiosity and initiative ([Bacigalupo et al. 2016](#)).

The findings contribute to the literature on the entrepreneurial intention by highlighting the role of curiosity and the complex dynamics of subjective norms in the engineering student context. We consider that the extension of the TPB, as we are proposing in the present study, is essential for understanding the antecedents of intentions and implicitly entrepreneurial behaviors and also provides a practical framework for the development of educational interventions aimed at encouraging the entrepreneur. This investigation contributes to the study of entrepreneurial intention in engineering students, particularly

through the expansion of TPB with curiosity. Further research could address these gaps to provide a more holistic understanding of the factors influencing entrepreneurial intention.

Altogether, the analysis of our results suggests that entrepreneurial education could contribute to a rise in the right attitude and in controlled behavior for countering negative influences arriving from outside the academia. Subjective norms should be taken into consideration by entrepreneurial education policymakers. It is important that entrepreneurial education programs include content targeted at developing subjective norms into a culture that encourages entrepreneurship. Such educational programs, when implemented very well, can significantly impact students' EI. Educational programs must be designed to change learners' perceptions of social pressure and risk in entrepreneurship, thereby stimulating curiosity and innovation in students. At the same time, future research should focus on such programs' impact on students' evolution. Such research would contribute to theoretical development and provide valuable insights for the practical design of entrepreneurship education programs.

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