

The Influence of Online University Education on the Creation of Sustainable Businesses

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Abstract

Purpose – *This study analyzes the influence of online university education, not only in fostering entrepreneurial intentions but also in the actual creation of sustainable businesses by students, while also considering the contribution of other academic, contextual, and personal variables.*

Design/methodology/approach – *A quantitative and cross-sectional design was employed, using structural equation modeling (SEM) to assess both direct and mediated relationships between online university education and the creation of sustainable businesses. Data were collected from an online Spanish university participating in the international GUESSS project. The sample consisted of 881 students.*

Findings – *The study demonstrates the positive impact of Online University Education, Career Intentions, and Level Of Studies, as well as the significant mediating role of University Climate and Knowledge Branch, highlighting the key role of the online academic environment in sustainable entrepreneurship.*

Originality – *This research is among the first to empirically examine the contribution of online university education to the actual creation of sustainable businesses by students, expanding the traditional focus on entrepreneurial intentions.*

Practical Implications – *The findings provide key insights for policies, teaching practices, and institutional strategies that promote online educational environments conducive to interdisciplinary and impactful sustainable entrepreneurship, with special attention to the role of University Climate and Knowledge Branch.*

Social Implications – *The results underscore the importance of promoting interdisciplinary approaches, strengthening sustainable institutional cultures, and fostering active learning methodologies to enhance the creation of sustainable businesses.*

Keywords

Online university education, business creation, sustainability, career intentions, level of education, knowledge branch.

Paper type *Research paper*

1. Introduction

Sustainable entrepreneurship prioritizes the balance between economic health, environmental resilience, and social equity to establish long-term growth and development opportunities for current and future generations (Rosário et al., 2022). Therefore, it is a concept that creates value by integrating three key dimensions (economic, social, and environmental). Although it originated in the late 1990s, it can still be considered a relatively novel idea (Calderón & Pelaez-Higuera, 2024).

Training is one of the tools that helps promote this sustainable vision (Truong et al., 2022). Several efforts have been made by universities to foster sustainable entrepreneurial intention, though not in the effective creation of businesses. Some of these efforts to encourage sustainable entrepreneurial intention have taken place in face-to-face settings (Waris et al., 2022; Sharma et al., 2023; Calderón and Pelaez-Higuera, 2024), while others have been conducted online (Hockerts, 2018; Ballesteros-Sola and Magomedova, 2023; Aceituno et al., 2024). It is particularly interesting that this vision of sustainable entrepreneurship reaches more students, including those who cannot physically attend university, so that their talent is not wasted. In this sense, online university training can facilitate the use of this talent and democratize access to this knowledge.

Online university education has become established as a distinct educational model. It is characterized by flexibility, autonomous learning, and a diverse student body, often including students with professional experience and entrepreneurial activities. This specific context may uniquely influence the development of entrepreneurial competencies, attitudes, and behaviours. However, despite its growing relevance, empirical evidence on its impact on the actual creation of sustainable businesses remains limited.

The Global University Entrepreneurial Spirit Student's Survey (GUESSS) Project provides data on actual business creation by university students, who are referred to as active entrepreneurs. Since 2003, this project has been the most important collaborative research observatory related to university entrepreneurship in the world, with data in its latest 2023 collection coming from universities from 57 countries and over 226,000 students (Sieger et al., 2024). Some of the participating countries, like Spain, include among their universities some dedicated to online education, and in their latest report have gathered data that provides new and important research opportunities related to sustainability. These data also make it possible to evaluate and apply theoretical models such as the Theory of Planned Behavior (TPB) to analyse how online university education influences the actual creation of sustainable businesses (Ruiz-Navarro et al., 2024).

All the previously stated evidence highlights a research gap regarding online university education in entrepreneurship and its impact on the creation of sustainable businesses, going beyond the mere promotion of entrepreneurial intentions.

To address this gap, this study proposes a model based on the Theory of Planned Behavior (TPB; Ajzen & Fishbein, 1975; Ajzen, 1991; Ajzen, 2002) that analyzes the influence of online

university education on the creation of sustainable businesses. The study provides empirical evidence from digital university contexts, extends the application of the TPB, and offers practical implications for universities and educational policymakers.

2. Literature Review

2.1. TPB and University Education in Sustainable Entrepreneurship

The Theory of Planned Behavior (TPB) is a well-established framework for explaining intentional behaviours and has been widely applied to entrepreneurship, serving as the foundation of the GUESSS Project. According to this theory, behaviours depend directly on the intention to act, which is determined by attitudes toward the behaviour, subjective norms, and perceived behavioural control. In the context of sustainable entrepreneurship, the TPB is particularly relevant because such initiatives involve complex long-term decisions that integrate economic, social, and environmental objectives. Within this framework, attitudes reflect individuals' evaluations of sustainable entrepreneurship. Subjective norms capture the influence of the university and the broader social environment. Finally, perceived behavioural control refers to individuals' confidence in their ability to engage in sustainable entrepreneurship, which can be strengthened through education and learning experiences.

Previous literature has extensively analysed the relationship between university education and entrepreneurial intention. In this regard, there are numerous scientific studies indicating that this type of training has had a positive influence on students' entrepreneurial intentions (Peterman & Kennedy, 2003; Paniagua-Rojano et al., 2014; Barnes & de-Villiers-Scheepers, 2017; Barba-Sánchez & Atienza-Sahuquillo, 2018; López-Meri et al., 2020; Aboobaker & Renjini, 2020; Barba-Sánchez et al., 2022; Lara-Bocanegra et al., 2022; Valenzuela-Keller et al., 2022; Ouragini & Lakhal, 2023; among others), and especially in the case of women (van Ewijk & Belghiti-Mahut, 2019; Bhatti et al., 2021). However, more recent studies show that during the pandemic period, university students' entrepreneurial intentions have declined (Hernández-Sánchez et al., 2020). Moreover, the scientific literature broadens this perspective, with cases in which in-person training has not been effective in promoting entrepreneurship (Oosterbeek et al., 2010; Souitaris et al., 2007; Von Graevenitz et al., 2010; Wegner et al., 2020).

Regardless of whether entrepreneurial intentions have been fostered to a greater or lesser extent, it seems that it is time for universities to go beyond merely encouraging such intentions. In this regard, Kuratko (2005) states that the field of entrepreneurship education is still not mature, although others, such as Katz (2008), argue that it is a mature field, but still has a long way to go before achieving full legitimacy compared to other business disciplines. Along these lines, Fayolle (2013) highlights the need to strengthen entrepreneurship courses. Furthermore, an in-depth study conducted by McNally et al. (2018) on the curricula of 50 university entrepreneurship courses worldwide concluded that both the use of textbooks and the course design are negatively related to the development of wisdom in the classroom.

Given this situation, and as previously stated in the definition of sustainable entrepreneurship by Rosário et al. (2022), this type of entrepreneurship seeks long-term growth, making it a key

element in entrepreneurial training to promote the effective creation of businesses. This sustainable approach facilitates opportunities aligned with global trends such as the circular economy and renewable energy, while also improving access to financing and incentives. It also enables differentiation in a demanding market, generating competitive advantages. Furthermore, it drives a mindset shift toward action, motivating individuals to undertake entrepreneurship with purpose. From the TPB perspective, this type of education can simultaneously influence attitudes, subjective norms, and perceived behavioural control, thereby fostering sustainable entrepreneurial behaviours.

2.2 Online University Education, TPB and sustainable entrepreneurship

As previously mentioned, the case of online education is particularly interesting, as it ensures that the talent of students who cannot attend university in person is not wasted and democratizes access to entrepreneurial knowledge. However, implementing online university education in entrepreneurship is not a simple task, even though it has expanded significantly due to the pandemic (Petrolo et al., 2023). Some studies (Cheah Soon Lee, 2022; Britton et al., 2022; Barrera-Verdugo et al., 2022; Romero-Rodríguez et al., 2022; Marzo-Navarro & Berné-Manero, 2023; Aubakirova et al., 2023) suggest that this educational modality may not be effective in developing students' entrepreneurial intentions. From the TPB perspective, these effects may be attributed to reduced social interaction, a weaker university climate, and limited exposure to face-to-face entrepreneurial networks, which can negatively influence subjective norms and perceived institutional support.

However, other studies report positive effects (Aceituno et al., 2014; Aceituno et al., 2015; Aceituno et al., 2018; Zulfiqar et al., 2021; Widjaja et al., 2022; Colombelli et al., 2022; Primario et al., 2022), which may strengthen TPB mechanisms. Temporal flexibility, autonomous learning, and compatibility with other professional or entrepreneurial activities can increase students' perceived behavioural control and self-efficacy, positively influencing their attitudes toward entrepreneurship and their entrepreneurial intentions.

In the field of sustainable entrepreneurship, empirical evidence on online university education remains limited. Some studies report positive effects on sustainable entrepreneurial intentions (Hockerts, 2018; Aceituno et al., 2024), mainly through the reinforcement of perceived behavioural control. The flexibility and compatibility of this modality can facilitate access to structured content, interdisciplinary approaches, and global perspectives on sustainability, allowing students to integrate these learnings with ongoing entrepreneurial activities. However, other studies find no significant effects (Ballesteros-Sola & Magomedova, 2023), which may be due to a weaker transmission of collective norms and values oriented toward sustainability in virtual environments.

Given all the points discussed above and the scarcity of studies linking online university education in entrepreneurship with its impact on the creation of sustainable businesses, it is important to highlight that, as previously mentioned, the GUESSS Project provides global data on the actual business creation by university students (Sieger et al., 2024). In this context,

among the participating countries, some—such as Spain—include universities dedicated to online education, whose data in the latest report have made it possible to identify new research opportunities related to sustainability (Ruiz-Navarro et al., 2024).

The GUESSS Project is grounded in the TPB, according to which entrepreneurial behaviour stems from intentions formed through attitudes, subjective norms, and perceived behavioural control. In the context of online university education, these mechanisms may be shaped by characteristics specific to this modality, such as reduced face-to-face interaction, a different configuration of the university climate, and greater student autonomy.

From this perspective, *Online University Education* operates as a broad institutional construct that can simultaneously reinforce attitudes and perceived behavioural control, and to a lesser extent subjective norms. By contrast, variables linked to the online university environment, such as the *University Climate*, primarily influence behaviour through subjective norms, the transmission of which may be weakened by lower levels of interaction and emotional engagement (Salta et al., 2022). *Career Intentions* reflect personal attitudes toward entrepreneurship and constitute a direct predictor of the creation of *Sustainable Businesses*. Likewise, the level of education strengthens perceived control, which may increase students' confidence in their ability to engage in sustainability-oriented entrepreneurship. Finally, *Gender* may influence perceptions of the environment and access to resources, affecting subjective norms and perceived behavioural control and, consequently, the likelihood of engaging in sustainable entrepreneurial activities.

However, in online environments, some of these effects may manifest with lower intensity or with a different direction than that observed in face-to-face contexts, particularly for variables strongly linked to social interaction and institutional climate. On this basis, and in line with the TPB, the following hypotheses are proposed in the context of *Online University Education*:

H1. *Online University Education* has a positive and significant influence on *Sustainable Businesses*.

H2. Perceptions of the *University Climate* have a significant influence on *Business Sustainability*.

H3. *Career Intentions* have a positive and significant influence on *Sustainable Businesses*.

H4. The *Level of Education* has a positive and significant influence on *Sustainable Businesses*.

H5. *Gender* has a positive and significant influence on *Sustainable Businesses*.

Given that this study focuses specifically on the relationship between *Online University Education* on and the creation of sustainable businesses, it is also relevant to consider the mediating mechanisms that explain how such education translates into entrepreneurial outcomes. In line with the TPB, the field of knowledge may shape how students interpret and apply sustainability-related content, influencing their perceived capacity to engage in sustainable entrepreneurship, while the university climate plays a key role in the transmission of subjective norms. Likewise, the level of education affects perceived behavioural control, and career intentions reflect personal attitudes that channel the impact of university education

toward the creation of sustainable businesses. Consequently, the following mediation hypotheses are proposed:

H6. The *University Climate* mediates the relationship between *Online University Education* and *Business Sustainability*.

H7. *Career Intentions* mediate the relationship between *Online University Education* and *Business Sustainability*.

H8. The *Level of Education* mediates the relationship between *Online University Education* and *Business Sustainability*.

H9. The *Knowledge Branch* mediates the relationship between *Online University Education* and *Business Sustainability*.

According to the proposed hypotheses, **Figure 1** visually illustrates the direct and mediated relationships between these variables, providing a representation of the mechanisms that affect the creation of sustainable businesses in the context of online university education.

Insert Figure 1: Model of Influence of Online University Education in the Creation of Sustainable Businesses

Source(s): Own elaboration

3. Methodology

3.1. Design of the Data Collection Plan

This study employs a correlational and cross-sectional design with the aim of analyzing the relationships between the variables of interest through structural equation modeling (SEM). SEM is a technique commonly used in sustainability studies to analyze latent variables and their interrelationships. It integrates multiple regression and factor analysis to examine both direct and indirect relationships between variables, usually represented through diagrams. Raw data has been processed and coded using SPSS 30 software to ensure consistency and the elimination of outliers or inconsistencies. As an initial analysis, frequencies and basic statistics were calculated to validate the quality of the database. Subsequently, means and standard deviations were calculated to understand the overall picture of the responses related to key variables. At this stage, a foundation was established to identify preliminary patterns and significant differences between entrepreneurial and non-entrepreneurial university students. For the main analysis, the SEM model was constructed using AMOS 26 software, allowing for the examination of structural relationships with a specific focus on the actual creation of sustainable businesses.

As previously mentioned, GUESSS is the largest research project on university entrepreneurship worldwide, with data from 57 countries and over 226,000 students (Sieger et al., 2024). In Spain, according to Ruiz-Navarro et al. (2024), the 2023 edition began preparation in early 2022 with the review and update of the common questionnaire, except for country-specific additional questions. The University of Cádiz (UCA) was responsible for the Spanish translation for Spanish-speaking countries. After online testing, confidentiality protocols were established, and public and private universities, as well as business schools, were invited to participate. In June 2023, the list of participating institutions was finalized, and they estimated the number of students to survey. At the beginning of September, the questionnaire link was tested again, and on September 4, the survey was activated, with internal distribution dates according to each university's schedule. During the process, weekly participation tracking reports were sent. Data collection ended on December 22, 2023. After cleaning and filtering the questionnaires, the final sample included responses from 78,889 Spanish students. Subsequently, the databases were sent to each university for processing and comparison with national and regional information. The sample error was 0.15 for a 95% confidence interval and 0.18 for a 99% confidence interval.

At Madrid Open University, out of the 7,701 enrolled students, 973 initial participants were obtained, resulting in a response rate of 12.63%. However, 92 questionnaires were excluded due to incomplete responses, so the final sample consisted of 881 participants, achieving a rate of 11.44%, significantly higher than the overall average of 4.74%. Regarding socio demographic data, 65.64% of the respondents were women. In terms of the level of studies, 57.49% were pursuing a bachelor's degree, 40.53% were pursuing a master's degree, 1.03% were working on a doctorate, and 0.9% were in other forms of education. Regarding the *Knowledge Branch*, 37.46% were studying a degree in the scientific-technical area, 27.19% were from the field of Economics or Business Administration, 15.87% were in the bio-sanitary field, 12.16% were in the humanities, and 14.28% were studying Law. Finally, in terms of entrepreneurial activity, 14% of the students were already entrepreneurs.

Madrid Open University has developed an innovative online educational model aimed at fostering sustainable entrepreneurship, integrating theory and practice and promoting collaborative work and the acquisition of competencies applicable in virtual environments. From the total database for Spain, the following variables from the questionnaire belonging to the analyzed University have been selected (see **Table 1**):

Insert Table 1: Model of Influence of Online University Education in the Creation of Sustainable Businesses

Source(s): Own elaboration

The structure of the questionnaire provided a comprehensive view of how various variables influence the creation of sustainable businesses by students, facilitating a detailed analysis of the determining factors in this process.

3.2. Data Analysis

Following the model generation strategy proposed by Jöreskog and Sörbom (1993), only those associations that were statistically significant upon running the model were included in the final model. The chi-square statistic (χ^2) and the chi-square value divided by degrees of freedom (χ^2/df) were considered, with values below or close to 3 indicating a good model fit (Bollen, 1989). Additionally, the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI) were evaluated. According to Hu and Bentler (1998), RMSEA values below 0.06 and CFI and TLI values above 0.95 indicate excellent model fit. Lastly, the Goodness-of-Fit Index (GFI) was included in the analysis; according to Jöreskog and Sörbom (1984), values above 0.9 indicate a good fit of the model.

The structural model is theoretically grounded in the TPB, which guides the specification of relationships among the constructs. Although the final model retains only statistically significant relationships, these associations were originally proposed based on this theoretical framework and are interpreted within that conceptual context, rather than as relationships derived exclusively from a data-driven exploratory procedure. Table 2 provides a brief guide to the acronyms and fit indices used throughout the manuscript.

Insert Table 2: Acronyms

Source(s): Own elaboration

4. Results

4.1. Test of the Reliability and Validity of the Measurement Model

A Confirmatory Factor Analysis (CFA) was conducted to assess the model fit and verify the factor loadings related to sustainable entrepreneurship (Business Sustainability), Online University Education, and University Climate. To evaluate the validity of these constructs, Cronbach's Alpha (α), Composite Reliability (CR), and Average Variance Extracted (AVE) were calculated.

During the validation process, one indicator from the *University Climate* construct was removed due to a low standardized factor loading (0.312), which did not meet the recommended thresholds. After this refinement, the remaining indicators of the construct showed standardized factor loadings of 0.735 and 0.721, both above the acceptable threshold. The AVE value reached 0.530, exceeding the recommended minimum of 0.50, thus supporting convergent validity. Although the reliability indices ($\alpha = 0.693$; CR = 0.6928) are slightly below the conventional threshold of 0.70, methodological literature indicates that values close to this level may be considered acceptable in exploratory contexts or when constructs are measured with a limited number of indicators (Fornell & Larcker, 1981; Hair et al., 2010). For the remaining constructs, all standardized factor loadings exceeded the 0.70 threshold. In particular, *Business Sustainability* showed very high levels of reliability ($\alpha = 0.981$; CR = 0.9855; AVE = 0.944), and *Online University Education* also demonstrated strong reliability and validity indicators ($\alpha = 0.956$; CR = 0.962; AVE = 0.809). Overall, the constructs were

considered reliable and valid, with Cronbach's alpha values close to or above 0.70, composite reliability ≥ 0.70 , and AVE ≥ 0.50 (see **Table 3**).

Insert Table 3: Factor Loadings of the Items by Construct

Source(s): Own elaboration

To evaluate the adequacy of a structural equation model (SEM), it is essential to consider various fit indices that help determine how well the proposed model represents the observed data. Among the most commonly used indicators are the Root Mean Square Error of Approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI). The RMSEA is an absolute fit index that penalizes model complexity, and values below 0.08 indicate an acceptable fit, while values under 0.05 are typically interpreted as indicative of a good fit (Browne and Cudeck, 1993). The CFI and TLI are incremental fit indices that compare the proposed model with a null model, i.e., a model assuming no relationships between variables. In both cases, values above 0.90 suggest an acceptable fit, and values above 0.95 are generally interpreted as evidence of an excellent fit (Hu and Bentler, 1999). As shown in **Table 34**, the RMSEA value was 0.03, the CFI was 0.994, and the TLI was 0.992, indicating that the model fit values are considered valid. Likewise, the chi-square value was 177.208 with 111 degrees of freedom (df), $p < 0.001$, resulting in a χ^2/df ratio of 1.808, which is within the acceptable range of less than 2.

Insert Table 4: Model Fit Indices

Source(s): Own elaboration

4.2. Convergent Validity

Convergent Validity assesses the degree to which the items measuring the same concept are correlated. A high correlation indicates that the measurement scale is capturing the intended construct. Many authors recommend using the Average Variance Extracted (AVE) to evaluate convergent validity (Fornell and Larcker, 1981; Byrne, 1994). On the other hand, Discriminant Validity measures the theoretical distinction between different constructs, which should have low correlations with each other. According to Fornell and Larcker (1981), discriminant validity can also be assessed using the AVE.

The reliability of the scales is assessed using the Composite Reliability Index (CRI) and the AVE. Acceptable thresholds are the recommended minimums of 0.6 for CRI and 0.5 for AVE (Hair et al., 2010). Discriminant Validity is determined by comparing the square root of the AVE for each construct with its covariance with any other construct in the model, ensuring that the variance shared between a concept and its measures is greater than the variance shared between constructs (Fornell and Larcker, 1981). Convergent validity was confirmed, as the correlations between constructs were lower than the square root of their respective AVE threshold values, and the square root of the AVE for each construct exceeded its inter-construct correlations. This indicates discriminant validity between the constructs (see **Table 45**). Likewise, **Table 6** summarizes the criteria used to assess convergent validity, demonstrating

that all constructs were conceptually distinct and did not show significant correlations that could compromise their validity.

Insert Table 5: Convergent Validity of the Constructs

Source(s): Own elaboration

Insert Table 6: Criteria Used to Assess the Convergent Validity of the Constructs

Source(s): Own elaboration

4.3. Structural Equation Model for Hypothesis Testing

The structural equation model for the conceptual framework hypothesized in this study was tested using the maximum likelihood estimation method (see **Figure 2**). The analysis yielded robust fit indices, as shown in **Table 4** and **Table 7**: NFI = 0.987; RFI = 0.982; RMR = 0.110; AGFI = 0.962; and GFI = 0.975. All these values met or exceeded the recommended thresholds for a well-fitting structural model. The coefficient of determination (R^2) for Business Sustainability was 0.310. This indicates that 31% of the variance is explained by the predictors included in the model, representing a moderate level of explanatory power. The results of the structural model show both direct effects and mediation relationships between the constructs, although not all hypotheses were fully confirmed. Out of the 9 hypotheses, 5 were supported (H1, H3, H4, H6, and H9), and 4 were not (H2, H5, H7, and H8).

Insert Figure 2: Results Diagram of the Proposed Model

Source(s): Own elaboration

Insert Table 7: Fit Indices for the Proposed Structural Model

Source(s): Own elaboration

Regarding direct relationships (see **Table 8**), the results of the structural model indicate that *Online University Education* exerts a positive and significant influence on *Business Sustainability* (H1: $\beta = 27.650$, $p < 0.001$). Similarly, *Career Intentions* show a positive and statistically significant effect (H3: $\beta = 0.092$, $p < 0.001$), as does the *Level of Education*, whose positive impact suggests greater perceived behavioural control as students' progress in their studies (H4: $\beta = 0.311$, $p < 0.001$). By contrast, *University Climate* shows a significant but negative relationship with *Business Sustainability* (H2: $\beta = -27.630$, $p < 0.001$), reflecting a specificity of the online context. Finally, the *Gender* variable does not show a statistically significant influence on business sustainability (H5: $\beta = -0.081$, $p = 0.425$), and therefore this hypothesis does not receive empirical support.

Insert Table 8: Direct Relationships in the Structural Model

Source(s): Own elaboration

Regarding the mediation effects (see **Table 9**), the results show that the *Knowledge Branch* exerts a positive and statistically significant mediating effect on the relationship between *Online University Education* and *Business Sustainability* (H9: $\beta = 0.44$, $p < 0.001$). Likewise, *University Climate* shows a significant mediating effect in this relationship (H6: $\beta = 1.00$, $p < 0.001$). By contrast, *Level of Education* does not exhibit a significant mediating effect (H8: $\beta = -0.08$, $p = 0.747$), nor do *Career Intentions* (H7: $\beta = 0.008$, $p = 0.271$).

Insert Table 9: Mediation Relationships in the Structural Model

Source(s): Own elaboration

5. Discussion and Conclusions

The results of this study make a significant contribution to the field of sustainable entrepreneurship in the university context, with particular attention to online education. Specifically, they show that *Online University Education* has a positive and significant influence on the creation of sustainable businesses. This finding is consistent with the TPB and reflects characteristics inherent to online environments—such as temporal flexibility, student diversity, and exposure to digital content—which can enhance learning and the application of sustainability-related knowledge. Although some research highlights the positive effects of entrepreneurship education on entrepreneurial intentions (Aceituno et al., 2014; Aceituno et al., 2015; Aceituno et al., 2018; Zulfiqar et al., 2021; Widjaja et al., 2022; Colombelli et al., 2022; Primario et al., 2022), studies addressing the sustainable approach within *Online University Education* are still limited and focused on the generation of entrepreneurial intentions as a preliminary stage before the actual creation of businesses (Hockerts, 2018; Aceituno et al., 2024). Although the study focuses on a single Spanish online university, the mechanisms identified, grounded in the TPB and linked to flexible learning structures and digital interaction, are not context-specific and are expected to operate similarly in other online higher education settings.

From a theoretical perspective, the results are interpreted coherently in light of the TPB, considering the specific characteristics of the online university environment and its impact on subjective norms, attitudes, and perceived behavioural control. The positive influence of *Online University Education* on *Business Sustainability* confirms the importance of academic training. As a broad institutional construct, it can operate through several TPB mechanisms. In particular, it may strengthen perceived support, favorable attitudes, and perceived entrepreneurial capability, even in virtual contexts. Likewise, the positive effect of *Career Intentions* reinforces the central role of personal attitudes in the realization of sustainable business projects, while the positive relationship of *Level of Education* suggests a progressive increase in perceived competence throughout the academic trajectory and in the capacity to engage in sustainable entrepreneurship. In contrast, the negative effect of *University Climate*

reveals a specificity of the online context: as highlighted in the literature, virtual environments tend to generate lower levels of interaction and emotional engagement (Salta et al., 2022), which may weaken perceptions of the institutional climate and its ability to directly influence entrepreneurial behaviour. Thus, although the university climate remains relevant, its direct influence takes different forms in online education. Finally, the absence of a significant effect of *Gender* indicates that, in this context, educational and structural factors prevail over gender differences in the creation of sustainable businesses.

Regarding the mediation relationships, the results highlight the key role of the *Knowledge Branch* and *University Climate* as mechanisms through which *Online University Education* translates into sustainable entrepreneurial outcomes. The *Knowledge Branch* shapes how students interpret and apply sustainability-related content, providing disciplinary frameworks and competencies that strengthen perceived behavioural control. In turn, the *University Climate* acts as a channel for the transmission of subjective norms, even when its direct effect is limited. By contrast, neither the *Level of Education* nor *Career Intentions* show a significant mediating role, suggesting that although they directly influence business sustainability, they do not constitute the main mechanisms through which *Online University Education* activates sustainable entrepreneurship.

Similarly, the obtained coefficient of determination reflects a level of explanation that can be considered moderate in social and educational research, highlighting that the incorporated variables contribute significantly to understanding the phenomenon. However, it also reveals that a substantial portion of the variance remains unexplained, suggesting that the creation of sustainable businesses in online university environments is a complex and multidimensional construct.

The findings offer clear practical implications for universities and educational policymakers focused on sustainable entrepreneurship. First, the results underscore the importance of strengthening sustainability-oriented content within online entrepreneurship education, ensuring that training not only transmits knowledge but also reinforces perceived behavioural control. In line with H2 and H6, special attention should be given to the design of the online *University Climate*: although its direct effect may be weaker or even negative, it remains a key mediating mechanism through which institutional values and subjective norms are transmitted. Therefore, universities should invest in strategies that enhance interaction, emotional engagement, and visible institutional support for sustainability in virtual environments. At the policy level, promoting interdisciplinary structures and reducing barriers between knowledge branches can further improve the effectiveness of online education in fostering the creation of sustainable businesses.

This study presents some limitations that should be considered when interpreting the results. First, the cross-sectional design allows the identification of associations between variables. However, it limits the ability to establish definitive causal relationships because the data were collected at a single point in time. Second, the model provides a meaningful understanding of the factors influencing the creation of sustainable businesses, explaining a significant portion of the observed variability in this phenomenon. While this level of explanation is reasonable in

the social and educational domain, it suggests that there are other factors not considered that could have a significant impact on this process. Moreover, this study focuses on a single online university and does not conduct comparisons with other institutions. It should be noted that online universities are not the only institutions offering online courses, as traditional universities may also implement combinations of face-to-face and online teaching, which limits the generalizability of the results to other educational contexts.

Future research could explore other contextual and structural factors that affect the creation of sustainable businesses, such as the social environment, government policies, or access to resources. Longitudinal studies that follow students throughout their careers would provide deeper insight into how their intentions, attitudes, and perceptions evolve over time. The role of interdisciplinarity and collaboration across knowledge branches could be examined to better understand how they enhance sustainable entrepreneurship. Finally, the evaluation of specific online educational programs would help identify the most effective methodologies and content, particularly with regard to the influence of the university climate (H2, H6) and academic training on the creation of sustainable businesses.

In conclusion, this study provides evidence on the factors that influence the creation of sustainable businesses in online university contexts. *Online University Education*, *Career Intentions*, and *Level of Education* show positive effects, while *Knowledge Branch* and *University Climate* play a significant mediating role. Notably, *University Climate* remains a key vehicle for the transmission of norms and support for sustainable entrepreneurship, even in online settings. These findings highlight the potential of online academic environments to foster sustainable entrepreneurial behaviour and offer guidance for improving educational strategies aligned with sustainability values.

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Table 1

VARIABLE	ITEMS	SCALE
Level of Education	Level of Education	(1)
Knowledge Branch	¿A qué rama de conocimiento pertenece tu titulación?	(2)
Gender	What is your gender?	Dichotomous (0-1)
Career Intentions	What path will you try to follow once you finish your studies?	(3)
University Climate	At my university, there is a favorable environment for me to become an entrepreneur.	Liker 1-7
	At my university, I am encouraged to participate in entrepreneurial activities.	Liker 1-7
Online University Education	The courses I have taken increased my knowledge of the attitudes, values, and motivations for entrepreneurship.	Liker 1-7
	The courses I have taken increased my knowledge of the activities that need to be carried out to start a business.	Liker 1-7
	The courses I have taken improved my practical management skills for starting a business.	Liker 1-7
	The courses I have taken improved my skills for building networks.	Liker 1-7
	The courses I have taken encouraged me to identify business opportunities aligned with my knowledge and interests.	Liker 1-7
	The courses I have taken encouraged me to identify business opportunities closely related to trends, discontinuities, technological impacts, and other changes in the environment.	Liker 1-7
Business Sustainability	Contributes to campaigns and projects that promote the well-being of society.	Liker 1-7
	Highlights the importance of social responsibility for society.	Liker 1-7
	Participates in activities aimed at protecting and improving environmental quality.	Liker 1-7
	Aims for sustainable growth that takes future generations into consideration.	Liker 1-7

Table 2

Acronym	Full Name
TPB	Theory of Planned Behavior
SEM	Structural Equation Modeling
AVE	Average Variance Extracted
CR	Composite Reliability
α	Cronbach's Alpha
λ	Factor Loading
λ^2	Squared Factor Loading
ε	Error Variance
$\sqrt{\text{AVE}}$	Square Root of AVE
GUESSS	Global University Entrepreneurial Spirit Students' Survey
χ^2	Chi-square statistic
χ^2/df	Chi-square divided by degrees of freedom
CFI	Comparative Fit Index
TLI	Tucker–Lewis Index
RMSEA	Root Mean Square Error of Approximation
SRMR	Standardized Root Mean Square Residual
GFI	Goodness of Fit Index
AGFI	Adjusted Goodness of Fit Index

NFI	Normed Fit Index
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Table 3

CONSTRUCT	Charge	α	CR	AVE
(1) Business Sustainability				
		0.981	0.9855	0.944
Contributes to campaigns and projects that promote the well-being of society	0.969			
Highlights the importance of social responsibility for society.	0.978			
Participates in activities aimed at protecting and improving environmental quality.	0.968			
Aims for sustainable growth that takes future generations into consideration.	0.972			
Online University Education				
		0.956	0.9621	0.809
The courses I have taken increased my knowledge of the attitudes, values, and motivations for entrepreneurship.	0.874			
The courses I have taken increased my knowledge of the activities that need to be carried out to start a business.	0.901			
The courses I have taken improved my practical management skills for starting a business.	0.915			
The courses I have taken improved my skills for building networks.	0.858			
The courses I have taken encouraged me to identify business opportunities aligned with my knowledge and interests.	0.929			
The courses I have taken encouraged me to identify business opportunities closely related to trends, discontinuities, technological impacts, and other changes in the environment.	0.917			
University Climate				
		0.693	0.6928	0.53
At my university, there is a favorable environment for me to become an entrepreneur.	0.735			
At my university, I am encouraged to participate in entrepreneurial activities.	0.721			

Table 4

Adjustment Measures					
Index	Chi-squared	Chi-squared/df	RMSEA	CFI	TLI
Criteria		<5.0	< 0.08	> 0.9	> 0.9
Results	177.208	1.808	0.03	0.994	0.992

Table 5

	Business Sustainability	University Climate	Online University Education
Business Sustainability	0.972	0.102	0.123
University Climate	0.102	0.728	0.770
Online University Education	0.123	0.770	0.899

Table 6

Online University Education			Business Sustainability			University Climate		
λ	λ^2	ϵ	λ	λ^2	ϵ	λ	λ^2	ϵ
0.874	0.7639	0.2361	0.969	0.9390	0.0610			
0.901	0.8118	0.1882	0.978	0.9565	0.0435	0.735	0.5402	0.4598
0.915	0.8372	0.1628	0.968	0.9370	0.0630	0.721	0.5198	0.4802
0.858	0.7362	0.2638	0.972	0.9448	0.0552			
0.929	0.8630	0.1370						
0.917	0.8409	0.1591						
5.394	4.8530	1.1470	3.887	3.7773	0.2227	1.456	1.0601	0.9399
N = 6			N = 4			N = 3		
AVE 0.809			AVE 0.9443			AVE 0.53		
CR 0.9621			CR 0.9855			CR 0.693		

Table 7

Adjustment Measures					
Index	NFI	RFI	RMR	AGFI	GFI
Criteria	> 0.9	> 0.9	> 0.9	> 0.9	> 0.9
Results	0.987	0.982	0.11	0.962	0.975

Table 8

Hypothesis	Accepted	Estimator (coef)	p-value
H ₁ Online University Education --> Business Sustainability	Yes	27.650	< 0.001
H ₂ University Cimate --> Business Sustainability	No	-27.630	< 0.001
H ₃ Career Intentions --> Business Sustainability	Yes	0.092	< 0.001
H ₄ Level of Education --> Business Sustainability	Yes	0.311	< 0.001
H ₅ Gender --> Business Sustainability	No	-0.081	= 0.425

Table 9

Hypothesis		Accepted	Estimator (coef)	p-value
H ₆	University Climate --> Online University Education --> Business Sustainability	Yes	1.00	< 0.001
H ₇	Career Intentions --> Online University Education --> Business Sustainability	No	0.008	= 0.271
H ₈	Level of Education --> Online University Education --> Business Sustainability	No	-0.08	= 0.747
H ₉	Knowledge Branch --> Online University Education --> Business Sustainability	Yes	0.44	< 0.001

Figure 1

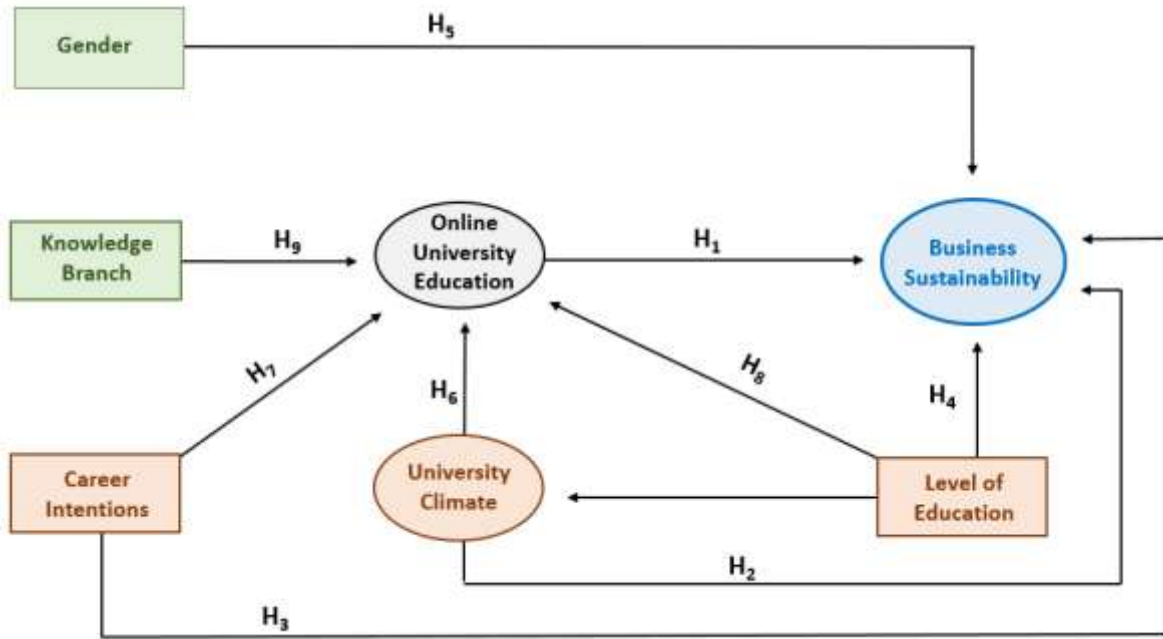


Figure 2

