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Bridging Theory and Practice: Challenges and Opportunities in Dual Training for Sustainability Education at Spanish Universities

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Abstract: This study investigates the implementation of dual training at the University of Extremadura (2023–2024), aiming to bridge theoretical academic knowledge with practical industry insights. This research utilizes SmartPLS 4.1.0.9 SEM-PLS software to explore the relationship between corporate engagement, academic outcomes, and sustainability challenges, validating hypotheses and refining dual training models in sustainability education. Key variables include Information Collection (IG), Sustainable Business Challenges (SCh), and Knowledge Developed by Business Strategies (KBS). The findings reveal that while the dual training model successfully integrates academic curricula with corporate engagement, it struggles to connect business strategies with actionable recommendations and has limited impact on improving teaching methods. This study identifies structural and practical barriers in the Spanish education system that hinder the full realization of dual training's potential. To address these challenges, this research recommends incorporating continuous feedback mechanisms throughout the learning process and enhancing mentorship opportunities. Continuous feedback would allow students to refine their conclusions, leading to more practical and sustainable solutions. Additionally, the use of authentic case studies and greater industry involvement would help students bridge the gap between theoretical knowledge and real-world applications, enabling them to generate actionable recommendations and better understand sustainability challenges and business strategies. These recommendations aim to improve student learning outcomes and strengthen the integration of academic and corporate practices, fostering more effective sustainability education.

Keywords: dual training; sustainability; higher education; industry alignment

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1. Introduction

Public universities in Spain encounter substantial challenges in accepting and implementing dual training for university students [1,2]. These challenges predominantly stem from structural, normative, and cultural factors deeply embedded within the Spanish public higher education system [2,3].

Several factors elucidate the regulatory inflexibility of Spanish universities. Local influences, including weak connections with vocational schools and low socio-cultural regard for dual training and employment, present significant obstacles to the transfer of dual training approaches [4]. Dual training offers a unique opportunity to bridge the gap between academic education and labor market needs, contributing directly to reducing youth unemployment. The successful implementation of dual systems in countries like

Germany has demonstrated the positive impact of integrating practical work experience with academic curricula, lowering unemployment rates among young people.

The rigidity of Spanish academic curricula impedes the integration of training models that require close coordination with companies and alternating study and work periods. The Organic Law 6/2001 of 21 December on universities provides minimal scope for considering active company participation in academic training. Professional qualifications through alternating periods remain unaddressed by university regulations [5]. Although there is some governmental support in this area, it has been insufficient to fully address these limitations. For example, the 2030 Agenda for Sustainable Development, particularly Target 4.7, advocates for the incorporation of sustainability and vocational education into academic training. However, the effective implementation of these objectives in Spanish universities remains limited. Furthermore, the Organic Law 4/2007 of 12 April, which amends the previous legislation, stipulates that the definition of academic programs is the exclusive prerogative of higher education institutions, thereby constraining the participation of external agents such as companies. Consequently, this legal framework precludes companies from designing and executing dual training programs.

This limitation derives not only from skepticism regarding the potential quality and rigor of dual programs but also from a perceived threat to institutional autonomy and academic integrity [6]. The role of companies is crucial in this regard. While some companies have shown strong support for dual training, others present challenges by arguing that integrating students into their operations increases costs and operational complexity. This discrepancy highlights the need for clear incentives to encourage active participation from the private sector [7].

The evaluation and accreditation processes of study programs play a critical role. Spanish public universities maintain that external actor participation does not guarantee students' acquisition of requisite competencies and knowledge. Dual programs consequently raise considerable concerns about universities' capacity to ensure compliance with academic standards and maintain educational quality [8].

The implementation of dual training programs additionally requires dedicated personnel for company coordination, internship supervision, facility adaptation, and additional resources. These requirements are essential for both parties, encompassing student candidate selection processes and the recruitment of participating companies through chambers of commerce, business associations, and databases of companies categorized by activity type [6,9].

Beyond the inherent rigidity of the university system, additional challenges emerge through the absence of clear incentives and external pressures to implement dual training. Well-established dual training programs remain the exception, with notable instances primarily confined to specialist disciplines such as Nursing Faculties [10] and Education [8,11].

In stark contrast to Spanish regulations, South Africa offers a markedly flexible regulatory approach with an open perspective towards dual training. The South African Higher Education Act of 1997 (Higher Education Act 101 of 1997) explicitly incorporates the labor market through dual training provisions. Article 7 empowers universities to "determine policies, procedures, and rules related to work-based learning, vocational training, and continuing education", thereby providing a comprehensive legal framework for implementing dual training programs.

Complementing this approach, the Skills Development Act of 1998 (Skills Development Act 97 of 1998) further reinforces the legal infrastructure in Article 16 by establishing a framework for "workplace learning". This encompasses dual training programs wherein students alternate between academic study and practical work periods within companies.

These initiatives have been strategically implemented to promote practical training integration among university students. A prime example is the Vocational and Occupational Training Program (VOCT) [12,13]. The program aims to strengthen the interconnection between academic training and the productive sector's needs across various professional domains, directly aligning with dual training objectives [14].

The acceptance of dual training within South African public universities has been a nuanced and uneven process. Nevertheless, the existing legal framework and supportive government policies provide robust foundations for implementation. Institutions that have embraced this model have successfully leveraged its advantages, including enhanced practical skills development, improved graduate employability, and more robust linkages between higher education and the productive sector.

Acknowledging the current shortcomings of the Spanish university system in embracing dual training throughout the academic period, this research presents an empirical case study of a dual program developed at the University of Extremadura (Spain) during the 2023–2024 academic year.

This empirical case offers insights into implementing dual training within the Faculty of Business, Finance, and Tourism, representing a preliminary step towards integrating such approaches into university students' curricula. A group of academic staff meticulously evaluated students' satisfaction with participation in the dual program and assessed the learning outcomes, which included company visits designed to provide practical training that complements the theoretical content delivered at the university. However, the novelty of this study lies in its focus on the integration of sustainability challenges within the dual training model, which has not been sufficiently explored in the existing literature. While dual training models have been examined in various educational contexts, the specific relationship between corporate engagement, academic outcomes, and sustainability challenges has not been adequately addressed. This study fills a critical gap by exploring how companies' environmental stewardship efforts can be integrated into academic curricula to enhance both student learning and practical, sustainable business strategies. The research contributes to refining dual training models with a focus on sustainability, offering actionable recommendations to overcome structural and practical barriers within the Spanish education system. This study directly addresses the gap identified in the literature by focusing on sustainability challenges within dual training models, offering new insights and practical recommendations to bridge the gap between theoretical knowledge and real-world industry practices.

The primary objective of this empirical research was to juxtapose theoretical university knowledge with practical information provided by corporate partners. Specifically, this study sought to comprehend the extent of companies' commitment to environmental stewardship through their policies, implementation processes, and resultant outcomes. Accordingly, what are the challenges and opportunities for integrating dual training programs into Spanish public universities, particularly in aligning academic curricula with the practical knowledge and environmental stewardship practices provided by corporate partners?

During the 2023–2024 academic year, a dual program activity was implemented targeting first-year students at the University of Extremadura. The program extended 80 places across a total of 20 companies. A substantial 300 students from seven distinct degree programs pre-registered, including Business Administration, Tourism, Finance, Law, Telecommunications, Software, and Computer Science. Student registration was conducted during September and October 2023.

Based on the potential empirical knowledge companies could provide to students, three key attributes were selected to facilitate student dual training. These objectives were also aligned with the companies' interest in complementing students' theoretical

knowledge across various disciplines, including Business Administration, Finance and Accounting, Tourism, Computer Science, Agricultural Engineering, Industrial Engineering, and Law (as detailed in Table 1).

Table 1. Types of company interests.

Key Attributes in Companies	Companies' Attributes According to
Business Process Optimization and Operational Efficiency	Business Administration and Finance: financial modeling, budget optimization, and supply chain analysis. Industrial and Agricultural Engineering: process redesign for production efficiency or sustainable agricultural systems. Computer Science: automating workflows, improving cybersecurity, or network optimization. Tourism: enhancing operational processes such as guest management systems or booking platforms. Law: reviewing and streamlining contracts or compliance processes to save time and resources.
Technology Development and Digital Transformation	Computer Science: developing apps, implementing artificial intelligence, and improving IT infrastructure. Agricultural Engineering: smart farming solutions using IoT devices or data-driven tools for crop management. Industrial Engineering: prototyping new machinery or integrating Industry 4.0 technologies. Business Administration and Tourism: implementing digital customer relationship tools (e.g., CRM platforms) or designing e-commerce solutions. Law: supporting legal tech tools like document automation or case management systems.
Strategic Planning and Market Research	Business Administration and Finance: conducting feasibility studies, market entry strategies, or pricing analysis. Tourism: identifying emerging travel trends, analyzing competitor performance, or crafting marketing campaigns for target audiences. Industrial and Agricultural Engineering: researching sustainable market practices or identifying new product opportunities. Law: performing legal risk assessments for potential business expansions or assisting with intellectual property research

Own source.

Before visiting the companies, students conducted research to deepen their understanding of the selected organizations. The aim was for students to familiarize themselves with the company's key characteristics and gain a deeper level of insight.

During November and December 2023, and February and March 2024, the companies hosted the students. Each organization managed various presentations at their workplace, covering topics such as their mission, objectives, core values, departments, and the operations of each unit or section. They also discussed the challenges they face, market difficulties, and the strategies they are implementing to expand their market. Table 2 presents the general attributes of the companies, organized by university degree.

For two weeks, students gained valuable insights into the concepts learned in class, observing their practical application. They interacted with executives and employees, who shared insights into day-to-day operations and the importance of each department within the company's organizational structure. They also acquired an insider's perspective on the company's training requirements, as well as the skills and competencies needed to join the organization upon completing their university studies.

Table 2. Attributes defined by university degrees.

Field	Mission	Defining Values	Functioning
Business Administration (ADE)	Optimizing organizational performance and foster sustainable business growth.	Leadership, Strategy, Innovation	- Marketing: manage campaigns and branding - HR: develop recruitment strategies
Finance and Accounting	Ensuring accurate financial reporting and sound fiscal management.	Transparency, Responsibility, Analytical Thinking	- Financial Planning: develop budgets and forecasts - Auditing: ensure accuracy and adherence to standards
Tourism	Creating innovative and sustainable travel experiences that benefit local communities	Hospitality, Cultural Sensitivity, Sustainability	- Guest Services: manage guest interactions - Marketing: attract new market segments
Computer Science	Driving technological innovation and provide digital solutions for complex problems.	Innovation, Accuracy, Problem-Solving	- Software Development: design apps and systems - Cybersecurity: protect company data
Agricultural Engineering	Promoting sustainable agricultural practices through technological advancement	Sustainability, Efficiency, Practical Innovation	-R&D: innovate farming equipment - Farm Management: optimize operations
Industrial Engineering	Improving industrial systems for maximum efficiency and productivity.	Efficiency, Safety, Quality	- Quality Control: monitor product standards - Process Engineering: optimize workflows

Own source.

During this period, the companies explained how they incorporate sustainability into their practices. They not only outlined the criteria followed to implement the SDGs but also discussed the outcomes achieved. Table 3 presents the results of incorporating sustainability, categorized by company type.

At the end of the three-week period, students were assessed by the companies based on criteria such as the level of knowledge acquired, proactivity during visits, and their positive attitude towards engaging with and showing interest in the topics discussed. The conclusions drawn from both the company and student perspectives highlight the significant learning achieved by students in an environment that fosters a keen interest in understanding the dynamics of the real market.

Students' learning through corporate internships and their engagement with sustainability has emerged as a critical consideration within the contemporary academic landscape. To address this, the present study proposes an investigative approach among participating students, focusing on one of the most recently implemented corporate imperatives: environmental stewardship.

In preparation for the internships, the research team convened two preparatory meetings with managers from the 20 participating companies. Sixty per cent of the invited organizations participated, with meetings conducted online due to geographical constraints precluding face-to-face interactions. These discussions served a dual purpose: not only to delineate the research process by establishing variables and indicators for measuring teaching enhancements, but also to explore potential interrelationships between variables.

This collaborative dialog aimed to establish robust connections that would contribute to the measurement of the proposed model and ultimate teaching improvement.

Table 3. Attributes defined by companies.

Field	Mission	Defining Values	Functioning
Business Administration (ADE)	Fostering sustainable business practices for long-term growth and societal well-being.	Ethics, Innovation, Responsibility	- CSR: implement sustainable policies- Marketing: focus on eco-friendly branding
Finance and Accounting	Managing finances responsibly while minimizing environmental and social risks.	Transparency, Accountability, Future-Oriented	- Green Finance: evaluate eco-project funding
Tourism	Creating eco-friendly travel experiences that benefit both the environment and local communities	Sustainability, Cultural Respect, Hospitality	- Sustainable Development: promote eco-certification - Marketing: focus on green destinations
Computer Science	Developing digital solutions that optimize resources and reduce environmental impact	Innovation, Responsibility, Problem-Solving	- Development: use green coding practices - Data Analytics: support environmental research
Agricultural Engineering	Advancing sustainable farming techniques and technologies that protect ecosystems	Sustainability, Efficiency, Environmental Stewardship	- R&D: innovate green machinery- Farm management: Optimize renewable energy usage
Industrial Engineering	Enhancing production processes while minimizing waste and conserving resources	Efficiency, Sustainability, Quality	- Process Engineering: integrate waste-reduction methods - Quality Control: ensure eco-friendly production

Own source.

The process of improving sustainability teaching in universities is predicated on these five principal variables. Indicators were assessed using Likert scales ranging from 1 (least significant) to 10 (extremely significant), enabling a nuanced quantitative evaluation of the research findings.

This approach represents a sophisticated attempt to bridge the gap between academic theory and corporate practice, offering students a comprehensive and critically engaged approach to understanding sustainability challenges. Accordingly, this study aims to explore the challenges and opportunities associated with implementing dual training programs in Spanish public universities, particularly in aligning academic curricula with the practical knowledge and environmental stewardship practices provided by corporate partners. The research focuses on identifying the key barriers and facilitators in integrating dual training programs into Spanish higher education institutions and determining how these programs can be optimized to enhance sustainability education.

2. Materials and Methods

The methodology design is structured through five distinct stages within a comprehensive process of enhancing sustainability education in universities, addressing both theoretical and practical dimensions:

2.1. Design of Variables

- Information Gathering (IG): Developing a nuanced understanding of the company prior to visitation, with a focus on identifying sustainability challenges. A series of carefully curated indicators are proposed to guide this investigative phase [15–17].
- Sustainable Business Challenges (SCh): Critically analyzing the organization's approach to complying with European environmental regulations [18–22].
- Knowledge Development through Business Strategies (KBS): Examining the strategic steps undertaken by the company to address initial challenges and enhance sustainability over the preceding five years. This stage involves active university lecturer participation to comprehend the discourse and solutions proposed by the corporate entity [21–25].
- Drafting Recommendations and Best Practices (DRBP): Synthesizing the student's findings from the preceding three stages into a comprehensive report [26–28].
- Teaching Improvement (TI): Developing theoretically grounded and practically applicable proposals to enhance sustainability education, drawing from the previous stages. These proposals incorporate innovative pedagogical approaches, including case studies, discussion groups, and illustrative examples [29–31].

2.2. Model Development and Indicators

Approaching the model's development, the research team convened several sessions divided into six distinct groups. Three hundred students of varying ages participated in the program.

The primary objective of these meetings was to elucidate the methodology for the program's second iteration. The intention was to assess the model's suitability among students, critically examining whether the proposed indicators and constructs would be embraced as a novel approach to dual training within the university, specifically from a sustainability perspective among first-year students.

According to the design, in April 2024, a provisional questionnaire was drafted and subsequently piloted with a cohort of 20 higher education students with similar demographic characteristics. These students undertook a comprehensive validation of the presented indicators. To evaluate their responses, a Likert scale ranging from 1 to 10 was implemented, allowing students to articulate their level of interest in incorporating each indicator. On this scale, 1 represented minimal interest, whilst 10 denoted maximum engagement. Statements translated into Likert scale-based questions are extracted from the following questions:

1. To what extent are you satisfied with the number of enterprises selected by each group of students?
2. How would you rate the variety of sources used for information collection?
3. How frequently do you believe updates on current regulations and trends were provided?
4. How effectively were specific obstacles identified?
5. How would you evaluate the quality of the proposed solutions?
6. How clear was the presentation?
7. To what extent did learners actively participate by asking questions to practitioners during the learning sessions?
8. How would you rate the quality of interaction with company staff when participants communicated their suggestions for improvement?
9. To what extent were comments incorporated into the reports submitted by participants?
10. How relevant and feasible do you consider the recommendations for compliance with European environmental regulations?
11. To what degree were the recommendations aligned with best practices in sustainability?
12. How clear and persuasive do you find the presentation?

13. How effectively were case studies elaborated by the teacher?
14. How well did the students propose discussion groups on the challenges posed by the company and ways to solve them?
15. How effectively were activities elaborated using gamification?

The refined language maintains the technical precision of the original text while adopting a more formal, academically oriented British English style, enhancing clarity and scholarly tone (Table 4).

Table 4. Constructs and indicators.

Constructs	Indicators
IG1	Number of enterprises selected by each group of students
IG2	Variety of sources used for information collection
IG3	Frequency of updates on current regulations and trends
SCh1	Identification of specific obstacles
SCh2	Evaluation of proposed solutions
SCh3	Clarity of presentation
KBS1	Active participation between learners and practitioners
KBS2	Quality of interaction with company staff
KBS3	Comments on reports submitted by participants
DRBP1	Compliance with European Environmental Regulations
DRBP2	Alignment with best practice in Sustainability
DRBP3	Presentation clarity and persuasiveness
TI1	Teacher case studies elaboration
TI2	Company challenges students' discussion groups
TI3	Gamification activities elaboration

Own source.

Figure 1 below displays the model connecting all the above constructs mentioned.

Based on the model in Figure 1, hypotheses are built to correlate constructs and through SmartPLS statistics software (version 4.1.0.9), these hypothetical correlations are to be tested in order for them to be accepted or discarded, regarding eight correlations as follows:

H1. *KBS connected to DRBP.*

H2. *KBS connected to TI.*

H3. *IG connected to KBS.*

H4. *IG connected to DRBP.*

H5. *IG connected to SCh.*

H6. *DRBP connected to TI.*

H7. *SCh connected to DRBP.*

H8. *SCh connected to TI.*

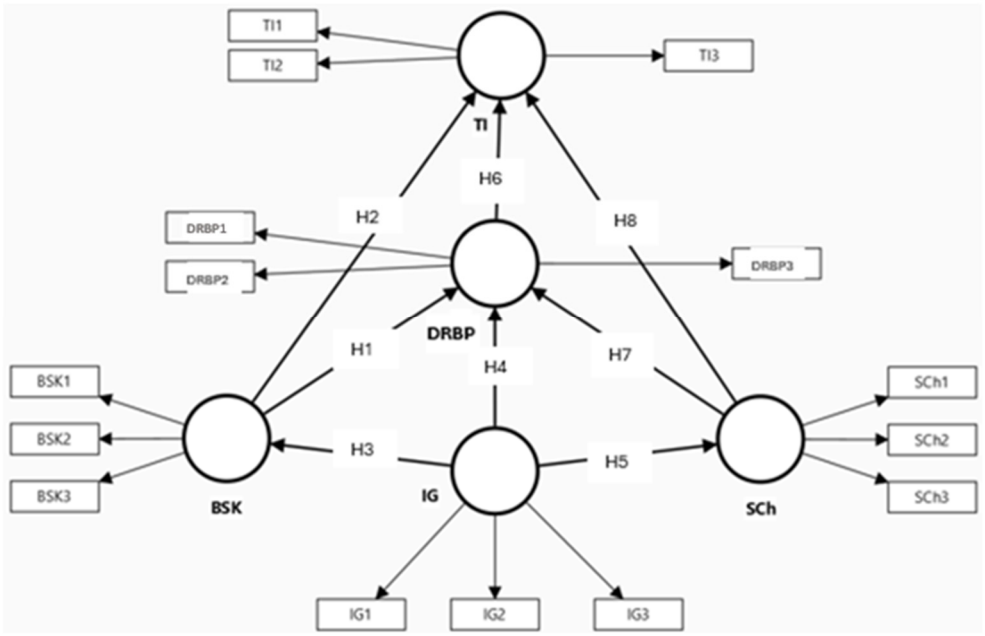

Figure 1. Constructs and indicators model.

SmartPLS 4.1.0.9 employed at the research is a powerful tool for Partial Least Squares Structural Equation Modeling (PLS-SEM). It offers significant updates and improved performance, making it ideal for analyzing complex models. That tool enhances the software's ability to handle larger datasets and more intricate models, while providing an intuitive user interface. The research examines the integration of academic curricula with real-world sustainability practices. SEM-PLS can effectively analyze the relationships between variables like corporate engagement, academic outcomes, and sustainability challenges, helping validate hypotheses and refine dual training models in sustainability education.

3. Results

3.1. Inner Model

In structural equation modeling (SEM), the "external model" refers to the relationships between observed variables (manifest variables) and their corresponding latent variables within the measurement model. This part of SEM elucidates how well the observed variables (such as survey items or test scores) reflect the underlying latent constructs they are intended to measure. The external model specifies the regression weights (factor loadings) that indicate the strength and direction of the relationship between each observed variable and its latent construct. Ensuring a well-specified external model is crucial as it validates the measurement model's ability to accurately capture the latent variables of interest, thereby providing confidence in interpreting the relationships assessed in the inner (structural) model of SEM.

In SmartPLS [32], Outer Loadings gauge the relationship strength between indicators and constructs. A threshold exceeding 0.7 denotes a substantial influence on the construct, validating its significance. These values serve as pivotal markers, affirming the reliability and validity of the constructs within the model. By surpassing this benchmark, researchers ascertain the robustness of their structural frameworks, enhancing the credibility of their analyses.

Outer Loadings beyond 0.7 underscore the pivotal role of associated indicators in elucidating the construct's multifaceted dimensions. Thus, meticulous examination of these loadings in SmartPLS elucidates the model's integrity, fortifying the empirical foundation of research endeavors, as shown by the index in Figure 2.

	KBS	IG	DRBP	SCh	TI
KBS1	0.824				
KBS2	0.843				
KBS3	0.926				
IG1		0.912			
IG2		0.844			
IG3		0.858			
DRBP1			0.817		
DRBP2			0.746		
DRBP3			0.831		
SCh1				0.893	
SCh2				0.863	
SCh3				0.909	
TI1					0.854
TI2					0.909
TI3					0.800

Figure 2. Outer loading.

3.2. Construct Reliability and Validity

In Structural Equation Modeling with SmartPLS, evaluating construct reliability and validity involves key metrics like Cronbach's alpha, Composite reliability (rho_a), Composite reliability (rho_c), and Average Variance Extracted (AVE). These metrics play distinct roles: Cronbach's alpha gauges internal consistency, while Composite reliability and AVE assess reliability and shared variance, respectively. While accepted thresholds may vary, researchers generally seek values above 0.7 for Cronbach's alpha and both forms of Composite reliability, and above 0.5 for AVE. These benchmarks ensure the robustness and validity of the constructs under examination, guiding researchers in building credible and reliable structural models within their analyses, displayed in Figure 3.

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
KBS	0.832	0.844	0.899	0.749
IG	0.843	0.858	0.905	0.760
DRBP	0.715	0.714	0.841	0.638
SCh	0.867	0.870	0.918	0.790
TI	0.816	0.827	0.891	0.732

Figure 3. Construct reliability and validity.

Cronbach's alpha reliability coefficient normally ranges between 0 and 1. A common threshold for acceptable composite reliability is often set at 0.7 or higher, as seen in Figure 3. Composite reliability (rho_c) meets an acceptable threshold (0.7 or higher) for all constructs, but the average inter-item correlation (rho_a) for the construct's items is over 0.7, what suggests that, as a whole, the construct exhibits less adequate internal consistency. The AVE should not be lower than 0.5 to demonstrate an acceptable level of convergent validity, meaning that the latent construct explains no less than 50% of the indicator variance, as it is shown in Figure 3.

3.3. Forner–Larcker Criterion and Discriminant Validity

The Forner–Larcker criterion and discriminant validity metrics crucially assess the differentiation between constructs. This is determined by analyzing correlations between constructs alongside their confidence intervals. According to [33], acceptable results typically involve values below 0.9, signaling sufficient discrimination between constructs. These metrics are essential for ensuring that the model accurately captures the unique contributions of each construct, bolstering the credibility and interpretability of the analysis. By examining these criteria, researchers can confidently validate the distinctiveness of their constructs.

The HTMT (Heterotrait–Monotrait) ratio is a measure used to assess discriminant validity between latent constructs [33]. It compares the correlations between indicators of different constructs (heterotrait correlations) to those within the same construct (monotrait correlations). Specifically, HTMT evaluates whether indicators of different constructs are less correlated with each other than with their own constructs. A value of HTMT less than 0.85 suggests adequate discriminant validity, indicating that the constructs are sufficiently distinct from each other.

In Figure 4 below, the left side displays Fornell–Larcker criterion versus HTMT Heterotrait criterion.

	KBS	IG	DRBP	SCh	TI
KBS	0.832	0.844	0.899	0.749	0.832
IG	0.843	0.858	0.905	0.760	0.843
DRBP	0.715	0.714	0.841	0.638	0.715
SCh	0.867	0.870	0.918	0.790	0.867
TI	0.816	0.827	0.891	0.732	0.816

	KBS	IG	DRBP	SCh	TI
KBS					
IG	0.755				
DRBP	0.397	0.614			
SCh	0.816	0.742	0.347		
TI	0.737	0.764	0.742	0.709	

Figure 4. Fornell–Larcker criterion versus HTMT Heterotrait criterion.

According to the Fornell–Larcker criterion, the square root of the average variance extracted by a construct must be greater than the correlation between the construct and any other construct; whereas the Heterotrait–Monotrait ratio of correlations (HTMT) is a statistical technique used to assess discriminant validity in business management research which acceptable level of discriminant validity is suggested to be less than 0.90, as shown in Figure 4.

In SmartPLS, Multicollinearity statistics (VIF) scrutinize the interrelations among predictor variables [34]. A VIF below 5 signifies acceptable levels, suggesting that multicollinearity's impact on the precision of estimated regression coefficients is negligible. This metric is pivotal in ensuring the reliability of regression analyses, as excessive multicollinearity can distort the interpretation of results and undermine the model's predictive accuracy. By adhering to the threshold, researchers can mitigate the risks associated with multicollinearity, fortifying the robustness of their analyses and enhancing the trustworthiness of their findings. Figure 5 shows collinearity statistics according to each indicator.

Indicators	Values	Indicators	Values	Indicators	Values	Indicators	Values
KBS1	2.135	IG2	2.268	DRBP3	1.654	TI1	1.849
KBS2	1.810	IG3	1.733	SCh1	2.300	TI2	2.423
KBS3	3.001	DRBP1	1.579	SCh2	2.058	TI3	1.701
IG1	2.767	DRBP2	1.238	SCh3	2.579		

Figure 5. Multicollinearity statistics (VIF).

Path coefficients illuminate direct relationships between variables [35]. Beginning with the null hypothesis (Ho) assuming no relationship between variables, T statistic values scrutinize the significance of these coefficients, while *p* values gauge the likelihood of similar results by chance. A coefficient achieves significance when T statistics exceed 1.96 in absolute value, and *p* values fall below 0.05, affirming substantial relationships between variables. Meeting these criteria validates hypotheses, enhancing confidence in the model's predictive power. Through meticulous analysis of path coefficients, meaningful insights are revealed, bolstering the empirical foundation of their analyses, as Figure 6 shows as follows.

	Original sample (O)	Sample mean (M)	2.5%	97.5%	P values
KBS -> DRBP	0.039	0.039	−0.094	0.170	0.562
KBS -> TI	0.282	0.283	0.190	0.378	0.000
IG -> KBS	0.646	0.648	0.583	0.710	0.000
IG -> DRBP	0.512	0.513	0.405	0.618	0.000
IG -> SCh	0.648	0.650	0.591	0.703	0.000
DRBP -> TI	0.402	0.401	0.331	0.468	0.000
SCh -> DRBP	−0.082	−0.081	−0.220	0.051	0.234
SCh -> TI	0.293	0.293	0.198	0.385	0.000

p-value < 0.01 (highly significant): 0.01 ≤ p-value < 0.05 (significant) : 0.05 ≤ p-value < 0.10 (marginally significant)

Figure 6. Path coefficients.

The Coefficient of Determination R^2 offers insights into the structural model's quality. An R^2 of 0.67 or higher signifies substantial explanatory power, around 0.33 denotes a moderate level, while near 0.19 suggests weak explanatory capability. With an R^2 value of 0.577, it lies inside the acceptable threshold, between 0.50 and 0.99. This robust R^2 underscores the model's ability to capture variance in the dependent variable, reinforcing the credibility of its predictive capacity [36]. The results highlight the dual training program's strengths and limitations. The model fosters integration between theoretical education and corporate practice, as evidenced by validated hypotheses (H2, H3, H4, H5, H6, and H8). Students demonstrated a deeper understanding of sustainability challenges and strategic corporate responses. For instance, information gathering effectively equipped students to analyze real-world environmental regulations and propose solutions. Testimonials reinforced this, showing how industry engagement enriched learning by bridging theoretical concepts with practical applications. However, challenges emerged in translating knowledge into actionable recommendations (H1 and H7). Students struggled to develop meaningful, context-specific solutions due to limited practical experience and a lack of direct mentorship from industry professionals. These gaps suggest the need for enhanced experiential learning opportunities, such as case studies, mentorships, and iterative feedback processes. While the model enhances sustainability education, further alignment between academic and corporate goals is necessary to ensure practical outcomes and teaching improvement. By adhering to established benchmarks, researchers gain valuable assurance in the model's efficacy, facilitating nuanced interpretation and informed decision-making within their analyses (Figure 7).

Figure 7 shows the values of the indicators, obtained throughout the previous calculations, together with each corresponding construct, to complete the model displayed in Figure 1.

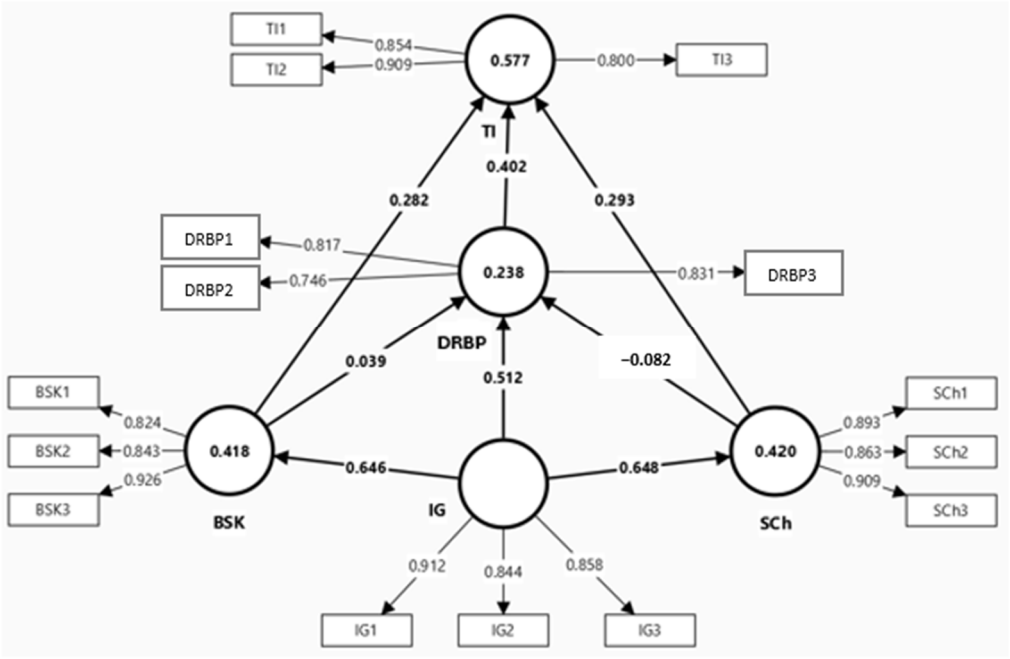

Figure 7. Constructs and indicators values.

4. Discussion

The research question is largely fulfilled by this study. The proposed dual training plan effectively integrates corporate engagement with academic curricula, offering students direct experience of sustainability challenges and business strategies. This study successfully demonstrates the relationship between academic and corporate practices through validated hypotheses, showing how information gathering, business strategy knowledge, and sustainability challenges enrich teaching. However, this study also highlights challenges, such as the failure to establish significant links between business strategies and actionable recommendations, indicating that the model could be further refined. To fully address the research question, this study suggests enhancing industry interactions and incorporating continuous feedback for more impactful learning outcomes.

This study also highlights the potential of dual training models in bridging theory and corporate practice in sustainability education for Spanish university students. It emphasizes the value of hands-on learning through direct interaction with companies to tackle real-world sustainability challenges. However, implementation in Spain faces significant obstacles, including rigid academic structures, low socio-cultural regard for dual training, and restrictive legal frameworks. While validated hypotheses showcase improved student understanding and engagement, challenges persist in translating theoretical knowledge into actionable solutions. Drawing on South Africa's regulatory success, this study recommends enhanced mentorship, authentic case studies, and continuous feedback to address structural and practical barriers.

The present study proposes a dual training plan targeting first-year university students, designed to establish direct corporate engagement. This innovative approach enables students to gain first-hand experience of management strategies, facilitating direct interactions with corporate personnel through structured meetings. A critical aspect of this student–company relationship involves comprehending sustainability challenges and critically analyzing implemented mitigation measures.

However, the challenges of implementing dual training in Spanish public universities are deeply rooted in structural, normative, and cultural factors, as identified by [1]. These obstacles, including weak connections with vocational schools and low socio-cultural

regard for dual training, significantly impede the transfer of such approaches [2]. The rigidity of Spanish academic curricula further hinders the integration of training models that require close coordination with companies [4].

Legal constraints imposed by the Organic Law 6/2001 and its 2007 amendment exacerbate these challenges, limiting the capacity for active company participation in academic programs [3]. This skepticism towards dual programs stems from concerns about the potential erosion of academic integrity and institutional autonomy. Furthermore, the lack of dedicated personnel and resources required for effective coordination with companies presents an additional barrier [6]. These challenges align with prior observations that dual training in Spain remains predominantly limited to specialist disciplines, such as Nursing [7] and Education [8].

In contrast, South Africa's Higher Education Act (1997) and Skills Development Act (1998) provide a comprehensive legal framework that facilitates dual training integration. These regulatory provisions empower universities to engage actively with the labor market through workplace learning initiatives [9]. South African universities have strategically leveraged these policies to enhance graduate employability and strengthen academia–industry linkages [11].

The proposed model demonstrates significant statistical robustness, with an R^2 value of 0.577, indicating a strong correlation between study variables and obtained results. Validated hypotheses illuminate the interconnected stages of the dual training model, demonstrating how academic–business integration can enrich sustainability education. Information gathering (IG) emerges as the foundational phase, equipping students with comprehensive insights into sustainability indicators and challenges. This preliminary stage transitions into analyzing sustainable business challenges (SCh), wherein students critically examine real-world environmental regulatory compliance, deepening their understanding of practical constraints.

Business strategies for knowledge development (KBS) subsequently emerge, enabling students to evaluate corporate strategic responses to sustainability challenges. This process facilitates the drafting of recommendations and best practices (DRBP), ultimately proposing actionable solutions to the identified gaps.

The failure of Hypotheses H1 and H7—indicates that business strategies do not significantly impact teaching improvement and that sustainable business challenges do not consistently translate into actionable recommendations—aligns with the existing literature. Students often acquire only superficial knowledge of business contexts, struggling to develop effective, context-specific solutions due to their limited practical experience and the inherent complexity of sustainability challenges [5].

In order to address these limitations, a multifaceted approach is recommended, which includes (a) providing students with authentic case studies; (b) establishing mentorship programs with industry experts; and (c) creating collaborative opportunities for strategy development.

Such interventions would effectively bridge the chasm between theoretical knowledge and practical application, enabling students to more comprehensively understand how business strategies manifest as actionable recommendations. Moreover, implementing continuous feedback mechanisms throughout the research process—rather than restricting evaluation to final presentations—would support students in refining their conclusions and developing more sophisticated, sustainable solutions.

The research objective is partially fulfilled. This study successfully juxtaposes theoretical knowledge with practical corporate insights through its dual training model. Validated hypotheses, such as H2, H3, H4, H5, H6, and H8, demonstrate that students gained a significant understanding of sustainability challenges and business strategies, enriching

their education and bridging theory with real-world applications. Student testimonials affirm these outcomes, highlighting improved engagement and comprehension.

However, the study's findings also highlight the structural and normative barriers identified in the Spanish higher education context [2,37–39], underscoring the importance of regulatory flexibility and stakeholder collaboration for successful dual training implementation [1–4]. Enhanced mentorship and experiential learning initiatives, as seen in the South African context, could offer valuable pathways to improve alignment between academic and corporate objectives, addressing gaps and facilitating the full realization of dual training's potential.

5. Conclusions

The research question can be answered by demonstrating how dual training programs bridge theoretical university education with corporate practices, particularly emphasizing environmental stewardship. This study concludes that collaboration between universities and companies is essential for aligning academic curricula with real-world sustainability challenges. To achieve this, a regulatory framework that promotes corporate involvement in designing academic programs is necessary. This is exemplified by South Africa's Higher Education Act and Skills Development Act, which facilitate university–industry partnerships.

Integrating dual training into Spanish universities can enhance students' understanding of corporate sustainability policies, management processes, and compliance with European environmental regulations. Practical experiences, such as company visits and the analysis of sustainability challenges over time, allow students to apply theoretical knowledge, thus improving their readiness for the job market. However, challenges arise in aligning these experiences with academic curricula. Active teacher participation is key in organizing such practical activities and updating teaching methods to bridge the gap between theory and practice.

The integration of dual training in particular, aligning academic curricula with the practical knowledge and environmental stewardship practices provided by corporate partners, requires a significant shift in educational models. Spanish universities may need to develop greater flexibility in their academic organization, revise existing laws, and allocate dedicated resources to overcome these barriers. On the other hand, this also presents an opportunity for universities to enhance their curricula with real-world sustainability insights, enriching students' learning experiences and preparing them for the evolving job market.

A regulatory framework should be promoted that encourages active participation from companies in the design and implementation of academic programs. Drawing inspiration from South African legislation, which links university education with labor market needs, greater flexibility in Spanish regulations could facilitate dual training and alternation between study and work periods. By implementing dual training, which combines academic study with practical experience in companies, Spanish universities could provide education that is more closely aligned with business realities. This integration of sustainability education into the curriculum would allow students to understand sustainability issues from a theoretical standpoint while also enabling them to apply that knowledge in real-world contexts. This approach significantly improves job market readiness by enhancing students' practical knowledge of sustainability challenges.

Furthermore, while dual training offers immense potential, it requires significant changes in the academic framework. Spanish laws should be revised to increase companies' involvement in academic training, particularly in sustainability-focused sectors. Sustainability should not be viewed as a standalone topic but embedded into the core curriculum of Spanish universities. Incorporating case studies on sustainability challenges, analyzing

European environmental regulations, and evaluating successful business strategies would provide students with a comprehensive understanding of sustainability. Additionally, developing specific indicators to guide data collection could help students gain a more hands-on perspective on sustainability challenges.

South African legislation offers a model for how a flexible regulatory framework can integrate dual training into academic curricula. The Higher Education Act (1997) and the Skills Development Act (1998) have facilitated close collaboration between universities and companies. Spanish universities could benefit from a similar model to improve dual training programs. This approach would require changes in both the academic and corporate sectors, requiring strong collaboration between all stakeholders to ensure the practical implementation of sustainability education.

The dual program not only contrasts theoretical knowledge but also prepares students to understand company management processes and analyze sustainability challenges. By assessing compliance with European environmental regulations, students can identify areas for improvement and comprehend regulatory implications in business practices. Teachers must be actively involved in organizing company visits and incorporating sustainability-related discussions into their teaching practices. This interaction allows students to witness theory applied in real contexts, providing teachers with updated knowledge and teaching methods. Based on experiences gained during visits, practical proposals can be developed to improve business management and sustainability education, further strengthening the link between theory and practice.

While the opportunities are abundant, the challenges are notable. One major challenge in Spain is the limited participation of companies in academic programs, which hinders the integration of practical experiences into university curricula. To overcome this, universities must develop a more flexible academic organization that can coordinate efficiently with companies. This may involve redesigning internship supervision systems, adapting academic facilities, and allocating additional resources to support the effective integration of dual training into academic programs.

One limitation of this study is that not all participants had prior company experience. This has been addressed by prior explanation of the benefits of the dual system. Moving forward, future research will focus on refining the phases of the model and analyzing responses from students in different degree programs to enhance the practical training aspects of sustainability education.

To bridge the gap between theoretical knowledge and practical corporate insights in sustainability education, the government should revise existing legislation to promote greater flexibility in academic curricula. This would allow universities to collaborate more closely with companies and integrate dual training models that alternate between study and work periods. By adopting such approaches, Spanish universities would benefit from a more practical and sustainable curriculum that meets the demands of both academia and the corporate world.

Universities and stakeholders should embed sustainability into curricula by including case studies on environmental challenges, European regulations analysis, and evaluations of successful business strategies. Structured corporate visits and internships should be prioritized, enabling students to apply theoretical knowledge in real-world contexts. Teachers must be equipped with the tools to organize such activities and ensure a seamless connection between academic concepts and business practices. Adequate resources must be allocated to facilitate the implementation of dual training, including funding for internship supervision, facility upgrades, and teacher training programs. Additionally, mentorship initiatives and feedback mechanisms should be established to guide students and refine the program based on evolving industry needs. By adopting these measures, the government

and stakeholders can significantly enhance the alignment between academic learning and corporate sustainability objectives programs into Spanish public universities presents both challenges and opportunities. One challenge lies in the rigidity of the current academic structures, which do not always facilitate smooth cooperation with external partners, such as companies. In particular, aligning academic curricula with the practical knowledge and environmental stewardship practices provided by corporate partners requires a significant shift in educational models. Spanish universities may need to develop greater flexibility in their academic organization, revise existing laws, and allocate dedicated resources to overcome these barriers. On the other hand, this also presents an opportunity for universities to enhance their curricula with real-world sustainability insights, enriching students' learning experiences and preparing them for the evolving job market.

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