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Competencies on sustainability and blue entrepreneurship in university guides: the challenge of a truly blue economy

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ABSTRACT

The inclusion of competences related to sustainability and blue entrepreneurship aligns with the 2030 Agenda, a global framework adopted by the United Nations to promote sustainability through 17 Sustainable Development Goals (SDGs). Universities, as agents of change, must address socio-environmental problems through research, education, innovation, collaboration, and sustainable practices, aiming for a positive societal and environmental impact. Through an R&D&I project under the Andalusian Plan for Research, Development, and Innovation conducted a study to diagnose the extent to which these competences are included in the teaching programs of nine Andalusian public universities. Using a mixed methodology, the study involved 22 teachers and analyzed 81 programs from 40 university degrees. Results show statistically significant differences by university and branch of knowledge, with Science and Engineering and Architecture incorporating these competences more extensively. The study indicates that sustainability is unevenly developed across universities, necessitating a review and modernization of study programs to meet the objectives of the Entrepreneurship Plan by the Conference of Rectors of Spanish Universities.

IMPACT STATEMENT

Investigating whether environmental education competencies are included in course syllabi is relevant because it allows for an assessment of whether educational institutions are preparing students with a vision committed to current environmental challenges.

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Competencies in sustainability; sustainability in education; blue entrepreneurship; higher education; Sustainable Development Goals

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Social Sciences; Development Studies, Environment, Social Work, Urban Studies; Education; Social Sciences; Education; Higher Education; Social Sciences; Education; Sustainability Education, Training & Leadership

Introduction

In the 21st century, sustainability and blue entrepreneurship have become essential for protecting the environment, promoting human well-being, economic prosperity, and global stability. The finite nature of natural resources and the need to preserve biodiversity have led to their integration across all sectors, aiming for a fair and sustainable future.

The blue economy refers to the set of economic activities that, without compromising the health of marine and freshwater ecosystems, sustainably use their resources to generate growth, employment, and well-being (Garland et al., 2019; Keen et al., 2018; Lee et al., 2020; Selamoglu, 2021).

Some authors also refer to the concept of the *Truly Blue Economy*, characterized by its focus on sustainability, emphasizing the importance of social equity and shared benefits, ensuring that marine economic sectors contribute to the Sustainable Development Goals and avoid negative social and ecological impacts. (Cisneros-Montemayor et al., 2019; Lee et al., 2020; Selamoglu, 2021).

The 2030 Agenda for Sustainable Development, adopted by all UN member states in 2015 (United Nations, 2015), established 17 Sustainable Development Goals (SDGs) and 169 targets, underscoring a global commitment to sustainability across economic, social, and environmental dimensions. This agenda

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provides a comprehensive framework for tackling global challenges, including poverty and climate change (Herranz-de la Casa & García-Caballero, 2020).

In this context, various authors highlight the pivotal role of universities as agents of social transformation and their essential commitment to regional development (Aparicio Chofré et al., 2022; Gutiérrez Mijares et al., 2023; Pegalajar-Palomino et al., 2022; Solís et al., 2022). These institutions not only serve as knowledge generators but also disseminate values fostering proactive, critical, and sustainability-minded attitudes among students (Pozo et al., 2023). The Conference of Rectors of Spanish Universities (CRUE, 2020) is dedicated to advancing significant progress in integrating the goals of the 2030 Agenda within the Spanish university environment. Spanish universities play a critical role in ensuring comprehensive education that addresses sustainability and blue entrepreneurship across diverse disciplines (Albareda-Tiana et al., 2018; Velasco et al., 2019).

In the Spanish context, institutional commitment to sustainability in higher education has been supported by specific policies for over a decade. In 2012, the Conference of Rectors of Spanish Universities (CRUE), through its Environmental Committee for Sustainable Development (CADEP), published the Guidelines for the Introduction of Sustainability in the Curriculum, a key document that proposes the mainstreaming of sustainability across all university degree programs (CADEP, 2012). More recently, the Proposal for Awareness-Raising Actions for the Implementation of the 2030 Agenda (CRUE, 2020) has served as a roadmap to guide universities in incorporating the Sustainable Development Goals (SDGs) into their academic, administrative, and research structures.

This process has been reinforced by legislative frameworks such as the Spanish Sustainable Development Strategy and the Organic Law of the University System (Ley Orgánica, 2023), which institutionalize education in sustainability, equity, and innovation as core principles of the university system. From 2015, the year the United Nations approved the 2030 Agenda, to 2020, the introduction of competencies related to the SDGs in Spanish higher education was actively promoted. The present study is situated precisely within this period of transformation and was developed during the 2022/2023 academic year.

To justify this integration, various educational and scientific policy documents—such as those produced by CRUE, CADEP, and international organizations like the UN—emphasize that universities bear a key responsibility in training professionals capable of addressing global challenges such as climate change, social justice, and sustainable economies (Albareda-Tiana et al., 2018; Gutiérrez Mijares et al., 2023; United Nations, 2015).

In this context, it is essential to define the core concepts of this study. Sustainability competencies encompass a set of cognitive, practical, social, and ethical abilities that enable responsible action in the face of sustainable development challenges. Authors such as Lozano et al. (2017) and Brundiens et al. (2021) highlight key competencies including critical thinking, anticipation, interdisciplinary collaboration, and informed decision-making. Sustainable blue entrepreneurship, on the other hand, refers to the creation of economic initiatives that promote growth and employment through the responsible use of marine and aquatic resources, without compromising the health of ecosystems (Garland et al., 2019; Lee et al., 2020). This vision, also known as the Truly Blue Economy, incorporates criteria of equity, social sustainability, and collective benefit (Cisneros-Montemayor et al., 2019).

Finally, the teaching guide represents the formal academic planning unit in which the competencies, content, methodologies, and assessment systems of each course must be explicitly specified. Its analysis enables the identification of the actual degree of alignment between the educational offerings and the principles of sustainability, social responsibility, and the blue economy (Mindt & Rieckmann, 2017; Poza Vilches et al., 2023).

Updating university competencies to align with new labor market demands and sustainable management practices is imperative for fostering social entrepreneurship and the blue economy (Brundiens et al., 2021). Despite growing demand for education in social and blue entrepreneurship, significant competency gaps remain (Portela et al., 2017). Thus, it's crucial to specify these topics in university curricula and teaching guides, emphasizing sustainability values throughout the teaching-learning process (Aguayo Arrabal & Gómez Parra, 2022; Fernández et al., 2023; Jekabsone & Ratniece, 2023; Kapranov, 2022; Poza Vilches et al., 2023; Reddy-Gavinolla et al., 2023).

Competency-based approaches are deemed essential for developing skills related to social and blue entrepreneurship (Vargas Mendoza et al., 2018). Hence, establishing a model and common reference framework for social entrepreneurship training is necessary (García-González et al., 2020; Villa et al., 2021).

Universities must pioneer critical perspectives fostering a more sustainable culture (Tekin et al., 2019). This is especially crucial given that these competences are not yet included in the curricula of many countries (Martínez Borreguero et al., 2020; Mogias et al., 2021). This commitment involves not only adopting sustainable practices and policies but also promoting awareness and action within the university community and society at large (Biasutti et al., 2016; Iqbal & Piwowar-Sulej, 2022). Incorporating competencies based on sustainable development and entrepreneurship into university teaching guides is crucial for equipping students to tackle the complex global challenges of our era (Hinojo et al., 2020; Kapranov, 2022; Mindt & Rieckmann, 2017; Salite et al., 2021).

The general objective of this research is to diagnose and explain the level of inclusion of competences on sustainability and blue entrepreneurship in the teaching programs of the different branches of knowledge of 9 Andalusian universities.

Thus, the research problem identified is that, despite the growing institutional and academic commitment to sustainability and blue entrepreneurship, the incorporation of these competencies into the teaching guides of public universities in Andalusia remains limited, uneven, and lacking clear systematization. This situation undermines the transformative role that universities should play in addressing current social and environmental challenges, hindering their alignment with the Sustainable Development Goals (SDGs) and with strategies promoted by organizations such as CRUE. In this context, it is necessary to rigorously analyze the extent to which these competencies are present and integrated into academic curricula, as well as the differences across institutions and fields of knowledge, in order to guide curricular review processes that support a university education more consistent with the principles of a truly blue and sustainable economy.

Against this backdrop, our research question is: Are competencies on sustainability and blue entrepreneurship included in the teaching programs of university courses?

In line with this, our research hypothesis is that the competencies related to sustainability and blue entrepreneurship are not sufficiently integrated into the teaching programs of public universities in Andalusia, appearing in a limited, uneven manner across degree programs and fields of knowledge, and lacking clear systematization.

In line with this, our research hypothesis is that the competencies related to sustainability and blue entrepreneurship may or may not be sufficiently integrated into the teaching programs of public universities in Andalusia, with potential differences depending on the university of origin and the academic field.

The specific objectives are the following:

1. To check whether the competences on sustainability and blue entrepreneurship are incorporated in the teaching guides of the different degree of the 9 Andalusian universities.
2. To analyze whether there are differences in terms of the incorporation of competences on sustainability and blue entrepreneurship depending on the university of origin and the branch of knowledge.
3. To check whether there are differences in terms of the incorporation of competences on sustainability and blue entrepreneurship considering jointly the University Origin and the branch of knowledge.
4. To analyze the most significant issues in each of the dimensions of the questionnaire relating to competences on sustainability and blue entrepreneurship in the teaching guides analyzed.

Materials and methods

This research, funded by the Andalusian Plan for Research, Development, and Innovation, adopts a mixed-method approach, combining quantitative and qualitative perspectives. Initially, an explanatory descriptive analysis was conducted utilizing frequencies and percentages to examine variables such as Universities, Branches of Knowledge, and Careers, along with various dimensions from the questionnaire.

Quantitative analysis involved inferential statistics, including an analysis of variance test (ANOVA) to identify statistically significant differences in the inclusion of sustainability and blue entrepreneurship competencies across universities and branches of knowledge. Subsequent Tukey's post-hoc tests and partial eta squared (η^2p) tests were employed to assess group differences and effect sizes. A multivariate analysis of variance (MANOVA) and post-hoc tests were conducted to examine differences between universities and branches of knowledge regarding survey dimensions. Data were processed using the statistical package SPSS, version 28. Additionally, qualitative analysis involved content analysis, focusing on identifying categories, subcategories, and their relationships, highlighting key topics. Qualitative data were analyzed using the ATLAS.ti program, version 22.

Participants

The sample for this study consists of 81 undergraduate courses from 40 different degree programs offered by the nine public universities in Andalusia that provide undergraduate education: University of Almería (UAL), University of Cádiz (UCA), University of Córdoba (UCO), University of Granada (UGR), University of Huelva (UHU), University of Jaén (UJA), University of Málaga (UMA), University of Seville (US), and Pablo de Olavide University (UPO). These universities make up the entire public higher education system in Andalusia.

The courses were selected through a non-probabilistic purposive sampling method, based on the accessibility of their respective course guides, which served as the main unit of analysis. These course guides were collected by a team of 22 faculty members participating in the research project. To facilitate and systematize the analysis of the teaching plans, a questionnaire was designed to serve as a guiding tool for the collaborating faculty members during the review of the course guides.

The sample includes degree programs from the five major fields of knowledge within the Spanish university system: (1) Arts and Humanities, (2) Social and Legal Sciences, (3) Sciences, (4) Health Sciences, and (5) Engineering and Architecture. Data collection was carried out during the first trimester of the 2022/2023 academic year. The process was complemented by regular meetings of the research team, aimed at the collaborative design and validation of the methodological instruments used in the study.

Procedure

In order to meet the objectives of this research, a mixed-methods design was employed, combining quantitative procedures with qualitative content analysis. Initially, a comprehensive literature review was conducted on sustainability and blue entrepreneurship competencies, drawing from sources such as CADEP (2012), Lozano et al. (2017), Albareda-Tiana et al. (2018) and Bacigalupo et al. (2022), along with peer-reviewed articles including those by García-González et al. (2020), Tójar and Estrada (2022), and Bianchi et al. (2022). These sources covered dimensions such as interdisciplinary work, anticipatory thinking, justice, responsibility and ethics, critical thinking and analysis, interpersonal relationships and collaboration, empathy and change of perspective, communication and media usage, strategic action, personal intervention, assessment and evaluation, and tolerance of ambiguity and uncertainty.

Based on this extensive review, a data collection instrument was developed, comprising 52 items grouped into 4 dimensions: Blue and Sustainable Entrepreneurship Competencies (BSUEC), Blue and Sustainable Entrepreneurship Perspectives/Approaches/Criteria (BSEPAC), Blue and Sustainable Entrepreneurship Values (BSEV), and Blue and Social Entrepreneurship Contents (BSOEC). The initial version underwent validation by 27 external professionals specializing in research methodology and blue sustainable entrepreneurship, who evaluated the content validity of each item. Their feedback was integrated into the final instrument, which retained the original 52 items, incorporating various formats including identification questions and a Likert scale ranging from 0 to 4. In this scale, 0 indicates no mention of competencies related to the survey dimensions in the degree subjects, while 4 indicates a perfect or nearly perfect alignment of competencies with the survey dimensions.

The questionnaire was structured to include closed questions assessing the level of general, basic, specific, and transversal competencies included in university curricula related to social entrepreneurship and sustainability. Additionally, open-ended questions were included to identify and categorize these

competencies. To ensure widespread distribution and accommodate the diverse nature of the sample, a Google Forms questionnaire was utilized.

Using the 52 Likert scale items as a foundation, an analysis of internal consistency (reliability) was conducted, yielding a Cronbach's alpha of 0.918, indicating high reliability in measuring a single construct with strong inter-item correlation. Construct validity was assessed through an exploratory factor analysis using the principal component method, which identified the underlying dimensions or factors of the instrument. The analysis revealed that the four components (dimensions) explained 80.392% of the total variability, indicating robust results. Additionally, each of the four dimensions demonstrated high reliability values, with Cronbach's alphas of 0.923 for BSUEC, 0.890 for BSEPAC, 0.924 for BSEV, and 0.877 for BSOEC.

To further support the validity of the instrument, conditions for the application of factor analysis were verified prior to extraction. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy yielded a value of 0.822, classified as meritorious, while Bartlett's test of sphericity was significant ($\chi^2 = 266.536$, $df = 6$, $p \leq 0.000$), confirming that correlations between items were sufficiently large for factor analysis. The exploratory factor analysis was carried out using the principal component method, and identified four components that matched the pre-established dimensions of the instrument collectively explaining 80.392% of the total variance.

The analysis was conducted on a sample of 81 university teaching guides in relation to 52 questionnaire items, resulting in a case-to-item ratio of approximately 1.56. Although this proportion is lower than the commonly recommended range of 5 to 10 cases per item, the statistical robustness of the results, evidenced by the high KMO value, significant Bartlett's test, and high reliability indices, supports the adequacy of the analysis. They all showed high values of reliability. For the factor analysis, the application conditions had been checked beforehand (KMO = 0.822 and Bartlett's test of sphericity: $\chi^2 = 266.536$, with 6 gl. $y p \leq 0.000$).

Results

A descriptive analysis based on frequencies and percentages was first carried out, where the mean of the Blue and sustainable entrepreneurship competencies (BSUEC) dimension was $\bar{x} = 1.683$, with a value of $S = 0.817$. In the second dimension Blue and sustainable entrepreneurship perspectives/approaches/criteria (BSEPAC), the mean was $\bar{x} = 1.368$ with $S = 0.908$. In the third dimension Blue and sustainable entrepreneurship values (BSEV), the mean was $\bar{x} = 1.352$ with $S = 0.980$. In the fourth dimension Blue and social entrepreneurship contents (BSOEC), the mean was $\bar{x} = 0.836$ with $S = 0.822$ (see Figure 1).

To address the specific objective number 2, and after verifying the hypothesis of normality ($p > 0.05$) through the Kolmogorov-Smirnov test and the homogeneity of variances using Levene's test ($p > 0.05$), the ANOVA statistical test (analysis of variance) was conducted.

The results of the analysis of variance (ANOVA) reveal significant differences in the inclusion of sustainability and blue entrepreneurship competencies among the universities studied.

In dimension 1, Blue and Sustainable Entrepreneurship Competencies (BSUEC), statistically significant disparities ($p < 0.05$) exist between UCA and UJA ($p = 0.009$), UHU ($p = 0.000$), and UCO ($p = 0.008$), as well as between UHU and UGR ($p = 0.033$). For instance, UCA incorporates competencies such as relating

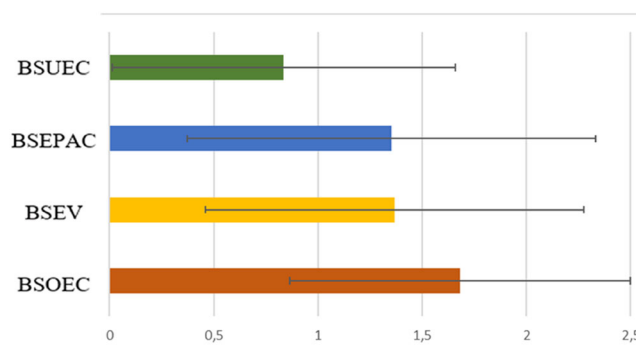


Figure 1. Mean scores and standard deviation of the sustainability and blue entrepreneurship competencies.

Table 1. Analysis of variance (ANOVA) between universities with statistically significant differences.

Dimensions	Universities	Universities	p-value
BSUEC	UCA	UJA	0.009
		UHU	0.000
		UCO	0.008
BSEPAC	UHU	UGR	0.033
		US	0.036
		UCA	0.002
		UPO	0.047
		UCA	0.012
BSEV	UCA	UMA	0.021
		UJA	0.004
		UHU	0.000
		UCO	0.013
		US	0.042
BSOEC	UCA	UJA	0.049
		UHU	0.021

Table 2. Analysis of variance (ANOVA) between branches of knowledge with statistically significant differences.

Dimensions	Branches of knowledge	Branches of knowledge	p-value
BSOEC	Science	Art and humanities	0.029
		Health Sciences	0.035
		Social and Legal Sciences	0.004

education to the environment and applying planning techniques for sustainable marine resource management, while UGR focuses on managing and conserving ecosystems.

In dimension 2, Blue and Sustainable Entrepreneurship Perspectives/Approaches/Criteria (BSEPAC), significant differences ($p < 0.05$) are observed between UHU and US ($p = 0.036$), UCA ($p = 0.002$), and UPO ($p = 0.047$), as well as between UCO and UCA ($p = 0.012$). Notably, US emphasizes valuing the social aspects of biological research, while UCA stresses environmental commitment and equitable resource use.

Dimension 3, Blue and Sustainable Entrepreneurship Values (BSEV), exhibits significant differences ($p < 0.05$) between UCA and UMA ($p = 0.021$), UJA ($p = 0.004$), UHU ($p = 0.000$), UCO ($p = 0.013$), and US and UHU ($p = 0.042$). UCA emphasizes sensitivity to environmental issues, while US focuses on assessing the environmental impact of buildings.

In dimension 4, Blue and Social Entrepreneurship Contents (BSOEC), significant differences ($p < 0.05$) are found between UCA and UJA ($p = 0.044$) and UHU ($p = 0.021$). Regarding branches of knowledge, significant differences ($p < 0.05$) are only observed in dimension 4 between the Sciences branch and Arts and Humanities ($p = 0.029$), Health Sciences ($p = 0.035$), and Social and Legal Sciences ($p = 0.004$). UCA, for example, includes competencies related to marine pollution and ecosystem conservation strategies (Table 1).

The effect size has been calculated using the η^2_p coefficient for the universities in the study, and a magnitude of 0.353 is observed in dimension 1 Blue and sustainable entrepreneurship competencies (BSUEC), 0.327 in dimension 2 Blue and sustainable entrepreneurship perspectives/approaches/criteria (BSEPAC), 0.369 in dimension 3 Blue and sustainable entrepreneurship values (BSEV), and 0.238 in dimension 4 Blue and social entrepreneurship contents (BSOEC) (Table 2).

The effect size has also been calculated using the η^2_p coefficient for the branches of knowledge in the study, and a magnitude of 0.023 is observed in dimension 1 (Blue and sustainable entrepreneurship competencies-BSUEC), 0.023 in dimension 2 (Blue and sustainable entrepreneurship perspectives/approaches/criteria-BSEPAC), 0.015 in dimension 3 Blue and sustainable entrepreneurship values (BSEV), and 0.186 in dimension 4 Blue and social entrepreneurship contents (BSOEC).

To complete the inferential analysis, a multivariate analysis of variance (MANOVA) was carried out, where the dependent variables correspond to the 4 dimensions in the survey, and the study factors were the university in question and the branches of knowledge.

For the multivariate contrasts, Pillai's trace, Wilks's lambda, Hotelling's trace and Roy's greatest root were obtained. The implemented F tests compared the multivariate effect by university and by branch

Table 3. Multivariate tests (MANOVA).

Effect	Contrast	Valor	F	gl. error	p	η^2p
Intersection	Pillai's trace	,857	58,651	39,000	,000	,857
	Hotelling's trace	6,016	58,651	39,000	,000	,857
	Roy's greatest root	6,016	58,651	39,000	,000	,857
University	Pillai's trace	,987	1,719	168,000	,015	,247
	Wilks's lambda	,293	1,793	154,000	,011	,264
	Hotelling's trace	1,572	1,843	42,000	,008	,282
Branches of knowledge	Roy's greatest root	,887	4,657	168,000	,000	,470
	Pillai's trace	,575	1,763	119,785	,040	,144
	Wilks's lambda	,480	2,034	157,273	,016	,168
	Hotelling's trace	,972	2,279	150,000	,005	,196
	Roy's greatest root	1,506	8,902	42,000	,000	,459

of knowledge. The following table shows the contrasts to accept or reject the null hypotheses of independence between the competencies and the universities and the branches of knowledge. The effect size was also carried out using the η^2p test (see Table 3).

Table 3 shows the importance of the universities, as well as the branches of knowledge in the model (with p-values that are all significant and with a large effect size). However, when the intersection of the model is observed, the effect size increases to 0.857.

A qualitative analysis was conducted on the open responses from the questionnaire, where teachers categorized competencies general, basic, specific, and cross-sectional found in teaching guides of various university degree programs. Using the ATLAS.ti program v.22, competencies were analyzed by dimensions, revealing multiple subcategories within each dimension.

The data were processed and analyzed using ATLAS.ti software (version 22), based on the four dimensions of the questionnaire, which served as predefined categories for the analysis. From this initial structure, a mixed categorization process was developed, combining deductive criteria with inductive elements. This approach enabled the identification of multiple subcategories within each main category, facilitating a deeper and more structured understanding of the diversity and specificity of the competencies included in the analyzed course guides.

In the Blue and Sustainable Entrepreneurship Competencies (BSUEC) dimension category, 3206 competencies pertaining to sustainable and blue entrepreneurship were identified, spanning 23 subcategories covering themes like learning from nature, management, self-motivation, resilience, proactiveness, and critical thinking. Within the Blue and Sustainable Entrepreneurship Perspectives/Approaches/Criteria (BSEPC) dimension category, 1441 competencies associated with perspectives, approaches, and criteria were captured, leading to 13 subcategories addressing topics like a culture of peace, equity approach, glocalization, social responsibility, and sustainability. The Blue and Sustainable Entrepreneurship Values (BSEV) dimension category yielded 1534 competencies linked to values, resulting in 14 subcategories encompassing environmental awareness, human rights, ethical responsibility, and social justice. Finally, in the Blue and Social Entrepreneurship Contents (BSOEC) dimension category, 537 competencies concerning sustainable and blue entrepreneurship were identified, leading to 8 subcategories covering environmental quality, blue/green economy, circular economy, and water-related issues, among others. Additionally, open-ended questions were included in the questionnaire to identify and categorize these competencies. The development of these subcategories was based on a systematic process of qualitative coding. From the analysis of the open-ended responses, the researchers identified recurring thematic patterns in the competencies described by the teachers. These patterns were organized around the four main dimension category of the study.

To ensure inter-coder reliability and consistency, cross-validation sessions and triangulation processes were conducted among the different coding teams. The aim was to guarantee coherence in the analysis through the consensual discussion and resolution of discrepancies.

For example, within the BSUEC dimension category, competencies related to resilience, resource management, and innovation were grouped into specific subcategories such as 'learning from nature' or 'proactiveness'. This process allowed for the structuring and visualization of the diversity and richness of the competencies present in university teaching guides, providing a clearer understanding of current educational approaches in sustainability and blue entrepreneurship (see Table 4).

Table 4. Competencies by category with examples.

Category	Competences	Examples of extracted statements
BSUEC	1.-Learn from nature 2.-To manage projects 3.-Automotivation 4.-Autonomy and self-learning 5.-Effective communication 6.-Management of complex situations 7.-Creativity, innovation 8.-Setting achievable goals 9.-Flexibility in the face of change 10.-Seeking sustainable entrepreneurial opportunities 11.-Initiative and pro-activity 12.-Interpret and manage emotions 13.-Investigating real world issues 14.-Motivating other people 15.-Critical thinking 16.-Anticipating possible negative social or environmental impacts 17.-Problem solving 18.-Responding effectively to situations of uncertainty 19.-Selecting better alternatives 20.-Overcoming adversity/Resilience 21.-Decision making 22.-Teamwork and cooperative learning 23.-Sustainable use of resources	GC2 Promote interest in and respect for the natural, social, and cultural environment through appropriate educational projects. GC4 Designing, planning, managing, and developing different resources, as well as evaluating plans, programmes, projects and activities of socio-educational intervention, social participation, and development in all areas. BC2 That students know how to apply their knowledge to their work or vocation in a professional manner and possess the competences that are usually demonstrated by means of the elaboration and defense of arguments and the resolution of problems within their area of study. TC23 Having sensitivity towards environmental issues. SC8 Being able to economically value goods, services, and natural resources.
BSEPAC	1.-Complexity (interrelatedness of complex ecosystems) 2.-Culture of peace 3.-Diversity / Plurality 4.-Equity approach (consideration of vulnerable populations) 5.-Integral education 6.-Gender perspective 7.-Glocalisation (think globally and act locally) 8.-Holistics 9.-Ethical management of finances 10.-Interdisciplinarity / Transdisciplinarity 11.-Social Responsibility 12.-Sustainability 13.-Transversality	GC6 Knowing and understanding the social responsibility derived from economic and business actions. TC10 Ability to recognise and respect diversity and multiculturalism to understand and accept social and cultural diversity as an enriching personal and collective component with the aim of developing coexistence among people without making distinctions of sex, age, religion, ethnicity, social and political condition. SC1 Ability to interpret and analyse societies in their spatial-temporal dimension.
BSEV	1.-Environmental awareness Coexistence 3.-Democracy 4.-Human rights 5.-Empathy 6.-Dignified employment 7.-Individual effort Ethical responsibility 9.-Involvement and commitment 10.-Social justice 11.-Participation (citizenship, students, young people ...) 12.-Environmental protection 13.-Corresponsibility (responsibility shared by several people) 14.-Transparency	BC1 Knowing and developing respect for and promotion of Human Rights, Fundamental Rights, the culture of peace and democratic awareness, basic mechanisms for citizen participation and an attitude towards environmental sustainability and responsible consumption. BC3 That students have the ability to gather and interpret relevant data (normally within their area of study) in order to make judgements that include the following to make judgements that include a reflection on relevant social, scientific or ethical issues. SC12 Managing structures and processes of community participation and action.
BSOEC	1.-Environmental quality 2.-Blue/green economy or other alternative economies 3.-Circular economy 4.-Aquatic ecosystems (rivers, seas, oceans, ...) 5.- Water-dependent ecosystems 6.-Problems associated with water 7.-Digitalisation (ICT) 8.-Alignment with Sustainable Development Goals (SDGs)	GC9 Develop creativity, initiative and entrepreneurial culture. TC22 Be motivated by quality. TC17 Initiative and entrepreneurial spirit referring to the predisposition to act proactively, putting ideas into action in the form of activities and projects to exploit opportunities to the maximum, assuming the necessary risks. SC38 Ability to assess and prevent natural risks

In the following table, competencies by dimension category are shown with examples of General Competencies (GC), Transversal Competencies (TC), Specific Competencies (SC) and Basic Competencies (BC).

From the qualitative analysis by dimensions of the questionnaire, we can see that, in the first BSUEC dimension category, it is where the teachers have expressed the most topics, with those related to resilience, proactivity, opportunities, entrepreneurship, anticipation and self-learning standing out, among others. With reference to the second BSEPAC dimension category, the topics most highlighted by teachers were plurality, diversity, culture, the ethical component, and peace. In the third dimension category,



Figure 2. Most prominent topics by dimension category.

responsibility is particularly highlighted, followed by environmental protection, empathy, and effort, and finally, in the fourth dimension category BSOEC, digitalization and the SDGs.

Four word clouds were created using this data, one for each dimension category, to highlight which topics stand out most in the analyzed competencies (see Figure 2).

Discussion and conclusion

The research delves into the integration of sustainability and blue entrepreneurship competencies within university teaching guides, identifying notable disparities across institutions and academic disciplines.

This research examines the current state of integrating sustainability and blue entrepreneurship competencies into university degrees, encouraging inter-university collaboration to advance curricular sustainability.

In addressing the first objective, it finds that while these competencies exist in teaching guides, their prominence varies among universities. Research by Albareda-Tiana et al. (2018), Sánchez Carracedo et al. (2021), and subsequent studies by Carlos et al. (2019) and Aznar-Minguet et al. (2017) underscore the inconsistent implementation of environmental competencies. Notably, the BSUEC dimension emerges prominently, whereas the BSOEC dimension receives less attention. Briens et al. (2023) and Xicoténcatl & Hernández-Romero (2020) emphasize the need for values-centered education to nurture socially conscious professionals.

In pursuit of the second objective, significant discrepancies are observed across universities, particularly highlighted by the distinct approaches of the University of Cádiz (UCA) and the University of Huelva (UHU). The study stresses the necessity for common criteria to align with the Entrepreneurship Plan outlined by the Conference of Rectors of Spanish Universities (CRUE, 2020). Notably, competency-based approaches in social entrepreneurship are deemed essential across all fields, echoing the sentiments of Vargas Mendoza et al. (2018) and Villa et al. (2021).

The third objective underscores the intersectionality of universities and branches of knowledge, revealing disparities in content integration. Velasco et al. (2019) note the disparity perceived by students

in Social and Legal Sciences regarding sustainable development and entrepreneurship content. The research aligns with this, emphasizing the need for comprehensive content inclusion.

Regarding the final objective, the study highlights the dominance of the BSUEC dimension, indicating a higher level of inclusion in teaching guides. Nonetheless, common themes such as 'capacity', 'teamwork', and 'specialization' persist across all dimensions, echoing findings by De los Ríos et al. (2015). Vera (2018) emphasizes the intrinsic nature of sustainability competencies in daily learning experiences.

To promote the blue economy in university education, effective educational practices must be implemented. These include experiential learning, industry collaboration, practical skill development, research opportunities, multidisciplinary approaches, technology integration, community engagement, international exchanges, sustainability literacy, and continuous learning. Such practices can inspire and equip students to contribute to the sustainable development of the blue economy.

Future research could focus on creating a model and reference framework for social entrepreneurship training, incorporating these competencies into teaching guides (García-González et al., 2020).

In conclusion, while competencies related to sustainability and blue entrepreneurship are included in university teaching guides, prioritizing social and environmental commitment in university teaching is necessary. Despite the contributions of this research, there are limitations, as not all curricula of the included universities were considered (García-González et al., 2020; Martínez Borreguero et al., 2020; Salíte et al., 2021), and the study focused solely on the educational aspect, despite sustainability being a multidimensional concept.

The results obtained in this study provide clear evidence of the uneven integration of sustainability and blue entrepreneurship competencies in university course guides. This should be interpreted as an opportunity to promote a systematic review of curricula. In this regard, universities can use these findings as a diagnostic basis to redesign their training programs, prioritizing the explicit and transversal inclusion of these competencies across all fields of knowledge, not only those traditionally associated with sustainability or environmental sciences.

A recommended first step is for the results to be reviewed by the quality assurance committees of degree programs, academic coordination teams, and teaching innovation leaders. A detailed analysis of the most underdeveloped dimensions, such as those related to blue and social entrepreneurship content (BSOEC), can guide continuous improvement processes that strengthen graduate profiles with a focus on environmental responsibility, sustainable innovation, and social commitment.

Among the practical recommendations derived from this study are: conducting a transversal curricular review by incorporating the analyzed competencies into both general and specific degree-level competencies, ensuring their presence in compulsory courses and not only in electives; designing specific subjects or common modules on sustainability and the blue economy to provide structured and coherent training in these areas; offering continuous teacher training focused on active methodologies and education for sustainability, enabling faculty to integrate these approaches into their teaching with a solid didactic foundation; and fostering collaboration with the productive sector and the third sector, promoting curricular internships, final projects (TFG/TFM), or initiatives linked to organizations working in the fields of sustainability, social entrepreneurship, or the blue economy.

With regard to knowledge transfer to other regions or university systems, the methodology used, particularly the design of the validated questionnaire and the mixed-methods analysis, can serve as a replicable model. Universities in other autonomous communities, European countries, or Latin American contexts may adapt this tool to their local realities to conduct similar diagnostics and guide improvements in their educational programs.

Furthermore, the dimension-based approach allows for the precise identification of aspects requiring greater attention and facilitates institutional comparisons. This modular structure can also be employed in accreditation processes, inter-university cooperation projects, or institutional strategies aligned with the SDGs.

Therefore, this study not only offers a snapshot of the Andalusian context but also serves as a useful tool for other higher education systems seeking to move toward a more sustainability-oriented, innovative, and socially transformative education.

Ethics approval and consent to participate

The authors of this manuscript state that ethical approval was not necessary for data collection in this study.

Authors' contributions

Miguel Ángel Fernández Jiménez: Investigation, methodology, writing original draft; reviewing and supervision.

Lourdes Aranda: Investigation, methodology, reviewing and supervision.

Esther Mena Rodríguez: Investigation, methodology, reviewing and supervision.

Disclosures and declarations

All the authors agree with the information provided and give their consent to the information provided.

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Data availability

The data used in this article have been obtained from surveys of study participants. Authors cannot share individual data but aggregate data included in the article tables.

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