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Implementing the Sustainable Development Goals in the Curricula of University Degrees: Initial Steps

Eva Gregori-Giralt [1], Carmen Benítez-Robles [2] and José-Luis Menéndez-Varela [1,*]

[1] Department of Art History, Faculty of Geography and History, Universitat de Barcelona, 08001 Barcelona, Spain; gregori@ub.edu
[2] Central Building, Online Design Program, Universitat Carlemany, AD600 Andorra, Andorra; cbenitezrobles@docente.ucarlemany.com
* Correspondence: menendez@ub.edu

Abstract

We introduce a model to gauge the implementation of the Sustainable Development Goals (SDGs) in the course syllabuses of university degree programmes. The model, comprising four category systems, is designed to analyse curricula that are still at an early stage of this process. The model is tested in Spanish public universities that offer master's degrees in Advanced Studies in Art History. A conventional content analysis is performed on 762 competencies across 82 subjects in five institutions. The results show that (a) 0.92% of competency codes were aligned with the SDGs, while 13.25% were merely related to them; (b) 48.02% were affected by repetitions of supposedly different competencies; (c) there was a mean value of 9.29 competencies per subject, and modal values of 1 and 4 subjects in which each competency was addressed; and (d) only 26.12% of the competencies were associated with high-level cognitive processes. In conclusion, a thorough reconceptualisation and reorganisation of curriculum maps is needed to adapt them for the SDG framework. The first steps are to promote high-level cognitive processes associated with competencies, eliminate repetition, reduce the number of competencies, increase the number of subjects addressing each competency, and organise the competencies into different performance levels.

Keywords: sustainable development goals; competencies; programme evaluation; evaluation methods; higher education

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1. Introduction

While there is no doubt that universities now take a growing interest in the concepts of sustainability, education for sustainability, and the Sustainable Development Goals (SDG) [1], it remains to be seen whether their commitment to the concepts has sufficiently become a reality in higher education. The concept of education for sustainability emerged from debates in environmental education, which had emphasised ecological problems, and in global education, which had focused on problems related to global social justice [2]. Today, the component of social and ethical responsibility inherent in the teaching of sustainability is not questioned [3]. This convergence of approaches has materialised in the concept of Education for Sustainable Development as defined by UNESCO [4] (p. 7): "The now well-established approach of Education for Sustainable Development (ESD) empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society for present and future generations".

Lange Salvia et al. [5] underscored the existence of a specialised literature that is much more extensive in the field of research and in the operational management of universities as institutions than in education itself. Moon et al. [6] noted that the majority of universities who are signatories to the United Nation's Higher Education Sustainability Initiative have undertaken a commitment only to achieve SDG 4 on quality education. Alba Hidalgo et al. [7] found that universities, in relation to environmental sustainability, have made some headway in the technical management of sustainability but not in driving forward the research and educational facets, which would indicate that their most pressing aim is cost savings.

Since the signing of the 2030 Agenda, it has become clear that an education for sustainability requires a systematic perspective that connects the updating of curricula with a comprehensive transformation of universities themselves [1,8]. While any steps to bring about the introduction of sustainability in curricula are doubtless welcome, the challenge cannot be met simply by scheduling an introductory subject on sustainability for all undergraduate students or by pursuing specific subjects in each undergraduate degree programme and including sustainability as a requirement in students' final projects. These measures are useful only at very early stages of implementation, whereas a full education for sustainability necessarily involves the extensive and intensive integration of sustain-ability in all course syllabuses [9]. Indeed, the debate over conceiving of its implementation as a stand-alone or embedded subject is in reality a debate over the dichotomy between the viability of implementation processes in a given situation and the deep learning of students. Moreover, the variety of approaches explains why Weiss et al. [10] tellingly distinguish between education about sustainability, education for sustainability and education as sustainability.

Given that competencies are the pillars of curricula and define the corresponding graduate profiles, the crux of the matter is to integrate the SDGs into the competency maps of all degree programmes [11], which does appear to be the current trend in European universities [12]. Such a perspective accounts for the different models that exist in relation to competencies in sustainability [13], the eight key competencies for sustainability put forward by UNESCO [4], and the proposal of four sustainability competencies set out by Conference of Rectors of Spanish Universities [14]. The risk here, however, is that the new competencies are poorly defined [15], or that there is an inadequate rollout of the competencies within the learning objectives and learning environments that should be enshrined in curricula and course syllabuses [16], or that the change is limited merely to adding new competencies to overly saturated curricula without actually reviewing them from the perspective of sustainability. Failing to give attention to these aspects could lead to a superficial implementation of an education for sustainability in the university context [17].

Creating a culture of sustainability in university degree programmes calls for a holistic perspective that specifically involves three interdependent levels of analysis: the institutional level, the curriculum level, and the instrumental or pedagogical level [18]. The second of these levels is the one taken up in the present paper. Under the auspices of the United Nations, ministries of education and universities, national quality assurance agencies, and university associations and networks that have emerged around the issue, research that is undertaken on the educational implementation of the SDGs has drawn on a variety of methodologies and sources of information [7], some of which have become international benchmarks. However, there is no lack of studies to critique such measurement tools as follows: (a) the vagueness of some of their key concepts; (b) the existence of biases in the preferred university models or in the weighting of the assessed university dimensions; (c) their poor adaptability to different contexts; and (d) the unintended consequences of

their use, for example, in university rankings [19,20]. Accordingly, universities should set up their own indicators to reflect their particular characteristics and the idiosyncratic nature of the sociocultural context that they serve [21], and they should use them to engage in reflection, discussion and exchange in higher education institution networks.

At the intermediate level of analysis, curriculum mapping is the most appropriate approach to examine the alignment of curricula with the SDGs, given that it involves an inventory of the academic offering, helps in the identification of advances and barriers in existing curricula, creates occasions for dialogue and commitment among the agents involved, and establishes a baseline to monitor the process and furnish valuable data for decision-making, communication and accountability [1,22–24]. The analyses of curriculum mapping fall into two overarching categories. The first category covers analyses that are based on searching for keywords in the curricula of degree programmes or in the syllabuses of their component subjects. Examples include the study by Hernández et al. [25] of the undergraduate programmes in two top universities in the QS World University Rankings of Chile, Colombia, Mexico and Peru; the study by Brugmann et al. [26] on the undergraduate course database of the University of Toronto; the study by Albareda-Tiana et al. [27] of the official reports prepared on 14 degrees offered by the Universitat Internacional de Catalunya; the study by Villà Taberner et al. [28] on a selection of subjects at the eight Catalan public universities; and the study carried out by Gómez-Martín et al. [29] on a Civil Engineering degree at the Universitat Politècnica de València.

The second category contains analyses that examine the alignment between the learning outcomes or competencies covered in subjects and some identifiable aspect of the sustainability paradigm. Examples include the analysis conducted by Orlovic Lovren et al. [30] on three faculties of the University of Belgrade, comparing the learning outcomes of subjects that already included the theme of sustainability with the learning objectives formulated by UNESCO to implement education for sustainable development goals [4]; the study conducted by Ya-Ching and Hsing-Lung [24], who studied the connection between the SDGs and core competencies at National University of Kaohsiung in Taiwan; the study by Kioupi and Voulvoulis [31] on the alignment of each programme's intended learning outcomes with sustainability attributes in 35 master's degrees in the UK and five at other European universities; the study by Rajabifard et al. [32] on the learning outcomes and subject contents of six schools at the University of Melbourne collected from the university's subject handbook; the study by Sánchez-Carracedo et al. [33] on the presence of the four sustainability competencies formulated by the Conference of Rectors of Spanish Universities (CRUE) in education degrees offered by seven Spanish universities; and the study by Poza-Vilches et al. [34], who set out their examination of the curriculum object-ives, content and competencies within syllabuses in the fields of education, humanities and environmental sciences at nine Andalusian public universities.

All of these studies have been conducted for a single university or a sample of universities, but none has taken on a single degree across the entirety of a national university system. This is particularly important because the scientific literature on sustainability in higher education has not reached a sufficient level of development: bibliometric studies carried out in WoS and Scopus have failed to yield more than 240 publications [11] and less than a third of them are empirical studies [35]. Against this backdrop, the aim of the present paper is to put forward an analytic model to examine the presence of the SDGs in degree programmes that are currently at an early stage of implementation. The goal has been to put together a simple diagnostic model so that a basic understanding of qualitative analysis will be sufficient for university teachers to apply the model, and so that it can be used by academic authorities at the faculty and department levels to draw up appropriate academic policies and lay the groundwork for accountability. The model has been tested through

an analysis of all Spanish universities that offer an official master's degree in Advanced Studies in the History of Art. Accordingly, three research questions have been posed: (1) What is the current level of implementation of the SDGs in the degree programmes under scrutiny? (2) What problems of distribution among the competencies in the curricula impede the introduction of the SDGs? and (3) What steps must be taken to promote the implementation process?

As for the structure of this article, Section 2 addresses the materials and methods, Section 3 shows the results, Section 4 covers the discussion, Section 5 presents the limitations and options for future research, and the conclusions are presented in Section 6.

2. Materials and Methods

2.1. Data Collection

With the aim of organising indicators for the presence of the SDGs in degree programmes and identifying any barriers that may hinder their implementation, the study examines the official master's degree in Advanced Studies in the History of Art across all Spanish universities where it is offered. For two reasons, the preferred option has been to analyse the course syllabuses rather than the formal reports on the degree programme sent to national quality assurance agencies for evaluation. The first reason is because the course syllabuses set out a more detailed description of the integration of the competencies into the learning environments of the subjects, while the second reason is because they offer a current snapshot of the degree, including any additions, deletions or modifications that affect particular subjects.

The analysis has looked at the generic course syllabuses of 82 subjects in the selected master's degree programme at the five Spanish universities where the degree is offered. These institutions are: the University of Barcelona (UB), which offers the official master's degree in Advanced Studies in the History of Art with a total of 16 subjects; the Complutense University of Madrid (UCM), with 14 subjects; the University of Zaragoza (UNIZAR), also with 14 subjects; the University of Oviedo (UOV), with 18; and the University of Salamanca (USAL), with 20. All of them are public universities with a long history and firmly established in the Spanish university system, offering a wide variety of undergraduate, master's, and doctoral degrees in the fields of Arts and Humanities, Social Sciences, Sciences, Health Sciences, and Engineering and Architecture. The websites of these five universities publicise their institutions' commitment to the SDGs reflected in regulations, list the internal entities that carry out work in this area, and describe the awareness-raising campaigns and the activities being carried out to implement a culture of sustainability in all areas of operation. They also report on actions to integrate the SDGs into teaching, a practice of particular interest to this research.

The production of generic course syllabuses is mandatory in the Spanish university system. In comparison to teacher-specific syllabuses, which are accessible only to the students enrolled in a subject and the group taught by a particular teacher, generic course syllabuses are available for public access. They convey a shared view of all the teachers who teach a particular subject and they serve as the subject's standard framework for students and teachers. In fact, after being drawn up by the teachers who teach the subject, the generic course syllabuses must be approved by each Department Council involved in the teaching of the degree. Thus, a generic course syllabus determines the academic framework to which a teacher-specific syllabus is subject and, unlike the latter, it cannot be modified over the course of the academic year. While the study of course syllabuses does not provide direct evidence of what actually occurs in the classroom [36], it does furnish information on whether the design of the curriculum and the teaching organisation of the subjects are consistent with the paradigm of an education for sustainability.

The structure of the generic course syllabus is set by each university. Although differences may exist between universities, the main components are the same. The shared sections include (a) identification data on the subject, academic year, teaching staff, department and ECTS credits; (b) distribution of the student workload by hours; (c) competencies and learning objectives; (d) thematic content; (e) teaching methods and activi-ties; (f) learning evaluation system; and (g) bibliography. The present study has reviewed only the information related to section (c) since the aim of this study is to analyse the alignment between the competency maps and the SDG paradigm. We will return to this issue in the following section.

2.2. Data Analysis

In accordance with Hsieh and Shannon [37], a conventional content analysis has been conducted on the generic course syllabuses of the selected master's degree. This is because the research consists of a qualitative study of the explicit and latent content of the text by means of a systematic procedure that permits the identification of key aspects, the determination of their specific weight, and the description of their interrelationships [38,39]. To this end, Nvivo 12 Pro software has been used. NVivo (Lumivero, Denver, CO, USA) is a collaborative qualitative analysis software that enables researchers to import, organise, explore and connect data in order to reveal meaningful insights from a qualitative perspective.

The generic course syllabus was therefore the unit of observation. The unit of analysis was the competency, given the current competency-based educational paradigm and the determining role that the international literature gives to competencies in the introduction of the SDGs in curricula. The competency description was the coding unit because it ruled out the need to use broader context units during the interpretation phase. As O'Connor and Joffe [40] have stated, preserving the original context in the coding units is a positive factor in the validity of their interpretation. In addition, settling on the coding unit eliminates any issues of reliability associated with coders' selection of segments of text that are of differing length [41].

The procedure used a combination of deductive and inductive approaches to establish the final category system. Addressing the first research question—What is the current level of implementation of the SDGs in the degree programmes under scrutiny?—required deductively creating an initial system called *Presence of the SDGs* based on the foundational documents of the 2030 Agenda [42]. The second research question—What problems of distribution among competencies in the course syllabuses impede the introduction of the SDGs?—called for the use of both approaches. The systems named *Types of competency* and *Cognitive processes* associated with the competencies was defined on the basis of the applicable legislation from the Spanish Ministry of Education and the academic regulations governing Spanish universities [43–46], while the so-called *Problem* system—which will not be addressed in the present paper—was built using an inductive analysis of the course syllabuses.

The reason for examining course syllabuses through the Presence of the SDGs, Types of Competency, and Cognitive Processes systems is that the aim of the present paper is to analyse the presence of the SDGs in degree programmes that are currently at an early stage of implementation. It is important to commence the process by reviewing the competency map in accordance with the 17 Sustainable Development Goals (SDGs) established by the United Nations, as well as the aspects related to competencies outlined in national regulations governing higher education. In the context of this research, the types of competencies and cognitive processes are documented within Spanish legislation and the academic regulations of Spanish public universities. The deductive approach applied to these systems is explained by the fact that the categories comprising them

were derived from this official documentation. The aim is to determine the extent to which the competencies outlined in the course syllabuses are aligned with this regulatory framework. Conversely, the Problem system resulted from an open coding process of these competencies, with the purpose of establishing labels that would subsequently define the categories it comprises. The approach here was necessarily inductive.

One of the researchers designed the deductive category systems, namely Presence of the SDGs, Types of competency and Cognitive processes, as well as an initial version of the coding frame that included the category labels and category definitions. After an initial calibration session to ensure that the three researchers agreed on shared meanings for the categories, the approach was applied to one of the official masters, which was coded independently by the researchers. In the wake of the test, a second calibration session was conducted to find any unintended problems with the deductive category systems and to present and define the categories obtained inductively in the Problem system. No frequencies obtained by the researchers in the analysed categories were compared in order to avoid any biases in the future study relating to inter-coder reliability as a result of what Hruschka et al. [47] call "interpretive convergence".

The obtained results called for a number of modifications so that the category systems would capture the studied phenomenon more faithfully. In the system called Pre-sence of the SDGs, it was necessary to add three new categories: two high-level categories—*Aligned competencies* and *Related competencies*—in which to organise any remaining competencies; and a third category—General approach—at the same level as the categories that capture the 17 SDGs. The system called Types of competency acquired the category of *Not specified* while, similarly, a new category of *Not codable* was added to the system Cognitive processes. All categories are described with examples in Section 3.1. Description of Category System.

Then, in order to assess the semantic validity of the category system [48], the proposed system was sent by email to 11 experts who have conducted similar studies on the implementation of the SDGs in their respective universities and degree programmes. None identified any irrelevant or inadequate aspects in three of the category systems used in the research; only the fourth one—the Problem system—required changes.

With the definitive version of the category system that resulted from the expert review, two of the authors once again coded a sample of master's course syllabuses separately. To assess intercoder reliability, Krippendorff's alpha coefficient was used for reasons set out in previous studies [38,49]. Table 1 shows that the alpha coefficients are greater than .80 in all systems of categories, except Problems, where it is .79.

Table 1. Krippendorff's alpha coefficients by category.

Competency System	N. Coders	N. Cases	N. Decisions	Krippendorff's Alpha
Presence of the SDGs	2	8	16	1
Types of competency	2	20	40	1
Cognitive processes	2	28	56	.88
Problems	2	32	64	.79
All systems	2	88	176	.89

Note. N. cases = Number of coding categories. N. decisions = Number of coding decisions made by two coders.

Regarding the coding process, each university was independently analysed by two researchers. Different working sessions were set up, attended by the three coders, in which each one coded the assigned universities. The purpose of these sessions was to discuss doubts regarding the coding process as they arose. The doubts affected the problem system; in some cases, it was necessary to review the coded competencies to align them with the decisions made. Once all competencies from the five universities had been coded in pairs, the three researchers jointly resolved any discrepancies.

3. Results

3.1. Description of Category System

In accordance with Mayring [48], the first result of the study is the category system itself (Table 2). The system is made up of 50 categories organised into three subsystems that have a variable number of categories: Presence of the SDGs, which has two intermediate categories that duplicate 18 smaller categories, one for each SDG and another one called General approach; Types of competency, which has five categories; and Cognitive processes, which has seven categories. The total number of categories is greater than the recommended limit for a system that is easy for researchers to work with: 10–30 for Mayring [48]; 30–40 for MacQueen et al. [50]. However, 36 categories in the system are the result of duplicating the 17 SDGs and the category General approach in the intermediate categories of Aligned and Related so that, for practical purposes, the total of categories is actually only 32.

Table 2. Category system.

Category	Description	Example [2]
Presence of the SDGs		
Aligned [This category includes subcategories for each of the SDGs and another one called General approach.]	Competencies whose definition or associated learning objectives mention the phrase "Sustainable Development Goal", the acronym SDG or some specific SDG by name.	CB8—For students to be able to integrate knowledge and grapple with complexity to make judgements based on incomplete or limited information including reflections on social and ethical responsibilities linked to the application of their knowledge and judgements. [Learning objective associated with the competency: Understanding the Sustainable Development Goals, their implications and opportunities in the field of the arts]
Related [This category includes subcategories for each of the SDGs and another one called General approach.]	Competencies whose definition or associated learning objectives do not mention the phrase "Sustainable Development Goal", the acronym SDG or any specific SDG by name. However, they clearly capture ideas related to the SDGs and their targets.	CB7—Knowing how to apply their acquired knowledge and problem-solving capacities in new or unfamiliar settings within broader (or multidisciplinary) contexts related to the history of art and feminism. [Connection to SDG 5: gender equality]
Types of competency		
Basic	Competencies established by Spanish law as common to all university degrees of the same level within the Spanish Framework for Higher Education Qualification (MECES, in Spanish). They must be identified in the generic course syllabuses.	CB9—Knowing how to communicate their conclusions and the knowledge and reasons that underpin them to specialised and non-specialised audiences in a clear and unambiguous manner.
Transversal	Competencies that are common to all university degrees of a single university. They must be identified in the generic course syllabuses.	Being able to apply scientific and discipline-specific knowledge in specialised professional practice.
General	Competencies that are common to all university degrees of a single university but are adapted to the specific context of each university degree programme. They must be identified in the generic course syllabuses.	CG6—For students to be able to recognise the complexity of diversity and multiculturalism in the contemporary world.
Specific	Competencies that are specific to a particular university degree programme and oriented to the achievement to the relevant graduate profile. They must be identified in the generic course syllabuses.	CE3—For students to know how to identify and formulate arguments about the relationships between thinking about art (Theory, Criticism, Aesthetic Thought) and the processes of artistic production throughout history.
Not specified	Competencies whose type is not identified in the generic course syllabuses.	Capacity to analyse the world of art from a sociological perspective.

Table 2. *Cont.*

Category	Description	Example [2]
Cognitive processes		
Remember	"Retrieve relevant knowledge from long-term memory." Includes: "identifying, retrieving." [1]	CG6—For students to know how to recognise the complexity of diversity and multiculturalism in the contemporary world.
Understand	"Construct meaning from instructional messages, including oral, written and graphic communication." Includes: "interpreting, exemplifying, classifying, summarising, inferring, comparing, explaining." [1]	CE7—To acquire notions of iconography and learn how to interpret icono-graphy in works of art.
Apply	"Carry out or use a procedure in a given situation." Includes: "executing, implementing." [1]	CG3—For students to be able to apply scientific and discipline-specific knowledge in specialised professional practice.
Analyse	"Break material into constituent parts and determine how parts relate to one another and to an overall structure or purpose." Includes: "differentiating, organising, attributing." [1]	For students to be able to develop complex cognitive processes of analysis and synthesis that will help them to formulate problems and plan comprehension strategies.
Evaluate	"Make judgements based on criteria and standards." Includes: "checking, critiquing." [1]	CG1—For students to be able to engage in criticism and self-criticism about the learning process and about their own work and the work of their learning group, evaluating improvement in the cognitive process.
Create	"Put elements together to form a coherent or functional whole; reorganise elements into a new pattern or structure." Includes: "generating, planning, producing." [1]	CG4—For students to be able to design and manage projects that are complex in intensity or length, evaluating the need to make timely decisions at each qualitative phase.
Not codable	Competencies whose definitions do not explicitly state their associated cognitive processes.	Public relations.

[1] Definitions of cognitive processes according to Anderson and Krathwohl [51]. [2] The column contains examples of competencies; the category of Aligned also contains other information from the generic course syllabus that is indispensable to understand the examples. The authors have added underlining to highlight key elements and brackets to add clarifications.

The first system, Presence of the SDGs, responds directly to the first research question: What is the current level of implementation of the SDGs in the degree programmes under scrutiny? The structure is simple: list the 17 SDGs and add the category of General approach to code any competences that mention the SDGs without specifying a particular SDG. The key to the system is the identification of the competencies that already include the SDGs—i.e., Aligned–along with other ones that could do so with only minor changes in their descriptions—i.e., Related. This offers a straightforward way to look more closely at the convergence between the curricula and the 2030 Agenda. In degree programmes with no presence or only a token presence of the SDGs, it is recommended that studies complement any analysis of competencies with an analysis of learning objectives. Given that any modifications of competencies require approval from the quality agencies, the groundwork for such modifications could be laid by working first on the learning objectives that deploy them within the course syllabuses.

The second system, Types of competency, responds to the second research question: What problems of distribution among competencies in the course syllabuses impede the introduction of the SDGs? Studying the organisation of the competencies in curricula lays a foundation to gauge their breadth and intensity; that is, the number of competencies that

a curriculum contains and their specific weight within the curriculum. Accordingly, it is possible to identify shortcomings in curricula that might undermine the implementation of the SDGs and impair the quality of learning environments. As previously discussed, competencies are categorised within the framework of the regulatory system governing higher education in Spain. In this context, it is necessary not only to identify issues related to the organisation of competencies but also to ascertain whether these different types of competencies exhibit varying levels of impact. This information is essential for prioritising actions aimed at improving curriculum redesign.

The third system, Cognitive processes, delves into these shortcomings by analysing the cognitive processes involved in the competency system. This system is complementary to the previous one insofar as it entails examining the intensity of the competencies: Types of competencies makes it possible to analyse such intensity in terms of how the competencies are distributed across different subjects, while Cognitive processes fosters a qualitative analysis of the core of each competency. Drawing up a map of the cognitive processes associated with the competencies is important for two reasons. The first reason is because the map provides evidence of the depth with which competencies are treated and the anticipated quality of the learning. Thus, cognitive mapping shows the purpose and educational approach of a degree programme. The second reason is because it shows a key aspect of the quality of the curriculum design: That the curriculum reflects an appropriate cognitive organisation for the achievement of the established learnings and thus refers to how plausible it is for students to meet the intended graduate profile.

3.2. Empirical Study

This is the analytic model that was used to examine the official master's degree programmes in Advanced Studies in the History of Art for the academic year 2024–2025 across the Spanish university system as a whole. Specifically, the study focused on five universities that offered the master's degree, involving a total of 82 subjects. From the analysis, 762 competency codes were obtained. Given constraints on length, only the calculations of significant frequencies will be presented. Tables 3 and 4 cross-tabulate the systems of Presence of the SDGs and Types of competency to show the absolute and relative values for the distribution of the SDGs by type of competency and their impact on the subjects.

Table 3. Presence of the SDGs in competencies or learning objectives.

University		Type of Competency										Total	
		Basic		Transversal		General		Specific		Not Specified			
		Aligned	Related	Aligned	Related	Aligned	Related	Aligned	Related	Aligned	Related	Aligned	Related
UB	CC	3	14		1	3	6	1	23		5	7	49
	DC	3	2		1	3	1	1	2		2	7	3
	SU	1	14		1	1	6	1	11		5	1	16
UCM	CC												
	DC												
	SU												
UNIZAR	CC										21		21
	DC										13		13
	SU										14		14
UOV	CC		11		14		6						31
	DC		2		1		3						5
	SU		11		14		4						14
USAL	CC												
	DC												
	SU												
Total	CC	3	25		15	3	12	1	23		26	7	101
	DC	3	4		2	3	4	1	2		15	7	10
	SU	1	25		15	1	10	1	11		19	1	44

Note. UB = University of Barcelona. UCM = Complutense University of Madrid. UNIZAR = University of Zaragoza. UOV = University of Oviedo. USAL = University of Salamanca. CC = Competency codes. DC: Different competencies. SU = Subjects.

Table 4. Presence of the SDGs in competencies or learning objectives (in %).

University		Type of Competency										Total	
		Basic		Transversal		General		Specific		Not Specified			
		Aligned	Related	Aligned	Related	Aligned	Related	Aligned	Related	Aligned	Related	Aligned	Related
UB	CC	1.60	7.49		0.53	1.60	3.21	0.53	12.30		2.67	3.74	26.20
	DC	3.85	2.56		1.28	3.85	1.28	1.28	2.56		2.56	8.97	3.85
	SU	6.25	87.50		6.25	6.25	37.50	6.25	68.75		31.25	6.25	100.00
UCM	CC												
	DC												
	SU												
UNIZAR	CC										14.19		14.19
	DC										10.00		10.00
	SU										100.00		100.00
UOV	CC		4.56		5.81		2.49						12.86
	DC		2.74		1.37		4.11						6.85
	SU		61.11		77.78		22.22						77.78
USAL	CC												
	DC												
	SU												
Total	CC	0.39	3.28		1.97	0.39	1.57	0.13	3.02		3.41	0.92	13.25
	DC	0.66	0.88		0.44	0.66	0.88	0.22	0.44		3.30	1.54	2.20
	SU	1.22	30.49		18.29	1.22	12.20	1.22	13.41		23.17	1.22	53.66

Note. UB = University of Barcelona. UCM = Complutense University of Madrid. UNIZAR = University of Zaragoza. UOV = University of Oviedo. USAL = University of Salamanca. CC = Competency codes. DC: Different competencies. SU = Subjects. UB: Total CC = 187; Total DC = 78; Total SU = 16. UCM: Total CC = 57, Total DC = 57, Total SU = 14. UNIZAR: Total CC = 148. Total DC =130, Total SU = 14. UOV: Total CC = 241, Total DC = 73, Total SU = 18. USAL: Total CC = 129, Total DC = 116, Total SU = 20.

The data show that the degree programme under scrutiny is at a very early stage of the implementation process for the SDGs. The analysis obtained only seven codes of SDG-aligned competencies; that is, only 0.92% of total competency codes. The seven codes were concentrated in one subject at a single university (amounting to 1.22% of total subjects) and they referred to seven different competencies (amounting to 1.54% of total competencies). Given such a meagre presence, any comment on their distribution by type of competency would not be salient.

The analysis of the SDG-related competencies failed to yield better results: while the coding in this case produced a total of 101 competency codes (13.25%), distributed across 53.66% of the subjects, only 10 different competencies (2.20%) were affected. Of the five universities, two (UCM and USAL) presented none and one (UNIZAR) did so only in competencies with no assigned type. The UB and UOV presented a similar distribution of competency codes, which were basically concentrated in two types of competencies: Basic and Transversal, in the case of the UOV, and Basic and Specific in the case of the UB. However, the codes for SDG-related competencies never exceeded 12.30% of the total for the UB degree programme or 5.81% for the UOV counterpart. Also, out of the 78 different competencies for the UB and the 73 for UOV, no more than three at each university were SDG-related competencies (2.56% and 4.11% of the total, respectively). That said, 100% of the UB subjects and 77.78% of the UOV subjects included SDG-related competencies of this sort, with the highest values reaching 87.50% in Basic competencies at the UB and 77.78% in Transversal competencies at the UOV. If we take the total number of subjects across the five universities, however, the share of affected subjects falls to 53.66%.

Table 5 sets out data that raise concerns over potential shortcomings in the organisation of the curricula. The first relates to the existence of a total number of coded competencies that may prove excessive in a master's degree of only 60 ECTS credits (European Credit Transfer System): UB, 78; UCM, 57; UNIZAR, 130; UOV, 73; and USAL, 116. The second relates to the lack of any rationale for the fact that 9.69% of the coded competencies across all universities offer no information about their type. That is, they are identified as Not specified. This state of affairs distorts the competency map and impedes further studies into the suitability of the distribution of competencies. The third issue is

related to the total of 48.02% of competencies that figure as supposedly different but are in reality the same, constituting a serious problem of curriculum organisation and raising concerns over potential errors in the description of the competencies. The coding of such competencies as different rests on one or more of the three following reasons: (a) they had an identifying code in some course syllabuses but not in others; (b) the competency in question was classified under different types of competency in the course syllabuses; and (c) there were significant variations in the wording. However, the description of the competences was exactly the same—reasons (a) or (b)—or the core of their descriptions included the same knowledge, skills, or attitudes—reason (c). The effect was uneven across the universities: 81.03% at the USAL, 56.41% at the UB, 50.68% at the UOV, 28.07% at the UCM and 20.77% at the UNIZAR. That said, however, the latter poses the problem that all of the competencies had to be coded as Not specified. The obtained percentages indicate that unnecessary repetitions in the description of the competencies exceeded 20% even in the least affected universities. The effects were similar among the different types of competencies (Basic: 56.67%, Transversal: 57.14%, General: 51.56%) with the exception of Specific (39.05%) and Not specified (84.09%). The latter type exacerbates the problems posed by this category of competency per se, underscoring the need to prioritise its review over the other types.

Table 5. Types of competency and their distribution by subject.

University			Type of Competency					Total
			Basic	**Transversal**	**General**	**Specific**	**Not Specified**	
UB	Competencies	N	15.00	11.00	12.00	25.00	15.00	78.00
		N%	19.23	14.10	15.38	32.05	19.23	100.00
		RE	8.00	5.00	5.00	15.00	11.00	44.00
		RE%	53.33	45.45	41.67	60.00	78.54	56.41
	Subjects	Mean	2.94	0.69	2.31	4.25	1.50	11.69
		Mode	1.00	1.00	1 & 4	1.00	1.00	1.00
		Min.	1.00	1.00	1.00	1.00	1.00	1.00
		Max.	8.00	1.00	7.00	6.00	3.00	8.00
UCM	Competencies	N			9.00	48.00		57.00
		N%			15.79	84.21		100.00
		RE			5.00	11.00		16.00
		RE%			55.55	22.92		28.07
	Subjects	Mean			0.64	3.43		4.07
		Mode			5 & 4	5.00		5.00
		Min.			4.00	4.00		4.00
		Max.			5.00	5.00		5.00
UNIZAR	Competencies	N					130.00	130.00
		N%					100.00	100.00
		RE					27.00	27.00
		RE%					20.77	20.77
	Subjects	Mean					10.57	10.57
		Mode					10.00	10.00
		Min.					9.00	9.00
		Max.					15.00	15.00
UOV	Competencies	N	12.00	1.00	28.00	32.00		73.00
		N%	16.44	1.37	38.36	43.84		100.00
		RE	9.00		10.00	18.00		37.00
		RE%	75.00		35.71	56.25		50.68
	Subjects	Mean	2.44	0.78	5.55	4.61		13.39
		Mode	2.00	1.00	6.00	3.00		
		Min.	1.00	1.00	1.00	1.00		1.00
		Max.	5.00	1.00	10.00	10.00		10.00

Table 5. *Cont.*

University			Type of Competency					Total
			Basic	**Transversal**	**General**	**Specific**	**Not Specified**	
USAL	Competencies	N	3.00	30.00	15.00	39.00	29.00	116.00
		N%	2.59	25.86	12.93	33.62	25.00	100.00
		RE		19.00	13.00	36.00	26.00	94.00
		RE%		63.33	86.67	92.31	89.65	81.03
	Subjects	Mean	0.15	1.80	0.75	2.01	1.65	6.45
		Mode	3.00	3.00	3.00	3.00	4.00	3.00
		Min.	3.00	1.00	3.00	1.00	1.00	1.00
		Max.	3.00	5.00	5.00	6.00	5.00	6.00
Total	Competencies	N	30.00	42.00	64.00	274.00	44.00	454.00
		N%	6.61	9.25	14.10	60.35	9.69	100.00
		RE	17.00	24.00	33.00	107.00	37.00	218.00
		RE%	56.67	57.14	51.56	39.05	84.09	48.02
	Subjects	Mean	1.15	0.74	1.96	2.94	2.50	9.29
		Mode		1.00	4.00	3.00	1 & 4	1 & 4
		Min.	1.00	1.00	1.00	1.00	1.00	1.00
		Max.	8.00	5.00	10.00	10.00	5.00	10.00

Note. UB = University of Barcelona. UCM = Complutense University of Madrid. UNIZAR = University of Zaragoza. UOV = University of Oviedo. USAL = University of Salamanca. N = number of different coded competencies; RE = number of times that competencies are repeated; Mean = average number of competencies associated with each subject; Mode = modal value of subjects that cover each competency; Min. = minimum number of subjects in which each competence appears; Max. = maximum number of subjects in which each competence appears. Number of competency codes: UB = Basic 47, Transversal 11, General 37, Specific 68, Not specified 24, Total 187; UCM = Basic 0, Transversal 0, General 9, Specific 48, Not specified 0, Total 57; UNIZAR = Basic 0, Transversal 0, General 0, Specific 0, Not specified 148, Total 148; UOV = Basic 44, Transversal 14, General 100, Specific 83, Not specified 0, Total 241; USAL = Basic 3, Transversal 36, General 15, Specific 42, Not specified 33, Total 129. Total number of subjects: UB 16, UCM 14, UNIZAR 14, UOV 18, USAL 20, total for all universities 82. Procedure: N% is calculated as a percentage of N out of total competencies for each university; RE% is calculated as the ratio of RE over N for each type of competence at each university; the mean for each university is calculated on the basis of the number of competency codes categorised in each type distributed across the number of subjects.

With respect to their distribution by subject, the mean, mode, and minimum and maximum values were calculated for the competency codes. A mean value of 9.29 competencies per subject indicates that the breadth of the competencies is too great and their treatment insufficient, thereby undermining the quality of the students' learning outcomes. Only the UCM (4.07) and USAL (6.45) have reasonable values. The other three universities have means greater than 10, while the most extreme case is that of the UOV, which has 13.39 competencies per subject. Such a breadth of competencies goes hand in hand with the lower intensity with which they will be addressed: each competency is customarily covered in only a few subjects, which can be seen from the modes of 1 and 4. With the exception of UNIZAR, which has a mode of 10, and UCM, which has a mode of 5, the other three universities do not have modes above 3. The predominance of minimum values of a single subject in all types of competency reinforces this tendency.

Table 6 sets out the cognitive processes associated with the coded competencies. The categories in this system, which are drawn literally from a revision of Bloom's taxonomy carried out by Anderson and Krathwohl [51], reflect the categories enshrined in the applicable legislation and the ones commonly used in academic regulations governing Spanish universities.

Table 6 adds relevant information on the level of intensity with which the competencies are addressed in the curriculum. Broadly, by organising the six categories of Anderson and Krathwohl's taxonomy into two blocks, it becomes clear that the three lower levels–Remember, Understand and Apply–account for 54.07% of total coded competencies, and lower cognitive process presents the highest frequency (22.83%). In addition, for a total of 19.82% of competencies, it was impossible to identify any of the categories in Anderson

and Krathwohl's taxonomy and they were coded as Not codable, pointing to an issue with their descriptions. Consequently, the high-level cognitive processes only reached 26.12%.

Table 6. Cognitive processes by type of competency.

University	Cognitive Process	Type of Competency										Total	
		Basic		Transversal		General		Specific		Not Specified			
		N	%	N	%	N	%	N	%	N	%	N	%
UB	Remember			1.00	0.53	14.00	7.49	28.00	14.97	4.00	2.14	47.00	25.13
	Understand	14.00	7.49	3.00	1.60			17.00	9.09	6.00	3.21	40.00	21.39
	Apply	13.00	6.95	2.00	1.07	9.00	4.81	13.00	6.95	4.00	2.14	41.00	21.92
	Analyse							4.00	2.14	2.00	1.07	6.00	3.21
	Evaluate	13.00	6.95	1.00	0.53	8.00	4.28	5.00	2.67	5.00	2.67	32.00	17.11
	Create	6.00	3.21	1.00	0.53	6.00	3.21	1.00	0.53	3.00	1.60	17.00	9.09
	Not codable	1.00	0.53	3.00	1.60							4.00	2.14
	Total	47.00	25.13	11.00	5.88	37.00	19.79	68.00	36.36	24.00	12.83	187.00	100.00
UCM	Remember					6.00	10.53	20.00	35.09			26.00	45.61
	Understand					1.00	1.75	1.00	1.75			2.00	3.51
	Apply					2.00	3.51	9.00	15.79			11.00	19.30
	Analyse												
	Evaluate							16.00	28.07			16.00	28.07
	Create												
	Not codable							2.00	3.51			2.00	3.51
	Total					9.00	15.79	48.00	84.21			57.00	100.00
UNIZAR	Remember									6.00	4.05	6.00	4.05
	Understand									36.00	24.32	36.00	24.32
	Apply									25.00	16.89	25.00	16.89
	Analyse									2.00	1.35	2.00	1.35
	Evaluate									23.00	15.54	23.00	15.54
	Create									27.00	18.24	27.00	18.24
	Not codable									29.00	19.59	29.00	19.59
	Total									148.00	100.00	148.00	100.00
UOV	Remember			14.00	5.81	34.00	14.11	27.00	11.20			75.00	31.12
	Understand	8.00	3.32			14.00	5.81	9.00	3.73			31.00	12.86
	Apply	7.00	2.90			16.00	6.64	12.00	4.98			35.00	14.52
	Analyse					2.00	0.83	7.00	2.90			9.00	3.73
	Evaluate	11.00	4.56					9.00	3.73			20.00	8.30
	Create					8.00	3.32	2.00	0.83			10.00	4.15
	Not codable	18.00	7.47			26.00	10.79	17.00	7.05			61.00	25.31
	Total	44.00	18.26	14.00		100.00	41.49	83.00	34.44			241.00	100
USAL	Remember	2.00	1.55	1.00	0.78	3.00	2.33	8.00	6.20	6.00	4.65	20.00	15.50
	Understand					1.00	0.78	8.00	6.20	2.00	1.55	11.00	8.53
	Apply			1.00	0.78			5.00	3.88			6.00	4.65
	Analyse			2.00	1.55	2.00	1.55	2.00	1.55	1.00	0.78	7.00	5.43
	Evaluate			9.00	6.98	2.00	1.55	4.00	3.10	4.00	3.10	19.00	14.73
	Create			3.00	2.33			2.00	1.55	6.00	4.65	11.00	8.53
	Not codable	1.00	0.78	20.00	15.50	7.00	5.43	13.00	10.08	14.00	10.85	55.00	42.64
	Total	3.00	2.33	36.00	27.91	15.00	11.63	42.00	32.56	33.00	25.58	129.00	100.00
Total	Remember	2.00	0.26	16.00	2.10	57.00	7.48	83.00	10.89	16.00	2.10	174.00	22.83
	Understand	22.00	2.89	3.00	0.39	16.00	2.10	35.00	4.59	44.00	5.77	120.00	15.75
	Apply	20.00	2.62	3.00	0.39	27.00	3.54	39.00	5.12	29.00	3.81	118.00	15.49
	Analyse	0.00	0.00	2.00	0.26	4.00	0.52	13.00	1.71	5.00	0.66	24.00	3.15
	Evaluate	24.00	3.15	10.00	1.31	10.00	1.31	34.00	4.46	32.00	4.20	110.00	14.44
	Create	6.00	0.79	4.00	0.52	14.00	1.84	5.00	0.66	36.00	4.72	65.00	8.53
	Not codable	20.00	2.62	23.00	3.02	33.00	4.33	32.00	4.20	43.00	5.64	151.00	19.82
	Total	94.00	12.34	61.00	8.00	161.00	21.13	241.00	31.63	205.00	26.90	762.00	100

Note. UB = University of Barcelona. UCM = Complutense University of Madrid. UNIZAR = University of Zaragoza. UOV = University of Oviedo. USAL = University of Salamanca. N = Number of competency codes. Total competency codes: UB 187, UCM 57, UNIZAR 148, UOV 241, USAL 129, Total for all universities: 762.

The predominance of low-level cognitive processes recurs in each of the types of competency and comes to an extreme case with the specific competencies, which account for 65.14% of the coded references of latter type (amounting to 20.6% of total competency codes). This piece of data might seem contradictory, given that the type in question defines the specialisation and specificity of any degree programme. The expectation of a master's

degree programme would be for it to have a predominance of specific competencies, which does occur in the studied case, as well as of high-level cognitive processes.

The analysis by university reproduces the same pattern among the lower and higher cognitive processes: UB, 68.44% and 29.41%, respectively; UCM, 68.42% and 28.07%; UOV, 58.50% and 16.18%; and UNIZAR, 45.26% and 35.13%. The only exception was the USAL, which presented very similar values across the two groups (28.68% and 28.69%, respectively), but also featured 42.64% of Not codable competencies. The UCM appears to present an atypical case, given that, with the exception of Specific competencies, the remaining types showed only low-level cognitive processes.

4. Discussion

4.1. The Category System

The proposed system is without precedent in the specialised literature. The aim of the system is to promote a deep-seated implementation of the SDGs in university degree programmes. As a result, the unit of analysis reflects the organising principle for degrees in the European Higher Education Area, namely competencies. However, the system could be applied perfectly well to learning outcomes in other university systems. The key element is that the intended competencies or learning outcomes of degree programmes are aligned with the SDGs and suitably distributed across the component subjects [31]. With respect to the current controversy between either introducing specific competencies for sustainable development [16,52] or adapting existing competencies in course syllabuses to the new paradigm [9,11], the authors support the second option. A thorough introduction of the SDGs will not arise primarily by adding new competencies that may be viewed as add-ons by the university community, but rather by reorienting the entire competency map towards sustainability. In addition, the excessive number of competencies in curricula impede the addition of other competences until the issue is sorted out. Thus, the proposed system responds to the belief that curriculum change begins with the systematic review and wholehearted modification of current competency maps, which would entail a sharp decrease in the number of competencies and their subsequent alignment with the underlying principles of an education for sustainability [53].

The system sets out a qualitative analysis of maps of competencies or learning outcomes that have 50 categories in total—reduced to 32, since there are repetitions—which are organised into three smaller subsystems. The subsystem called Presence of the SDGs helps in the identification not only of competencies in the course syllabuses that explicitly mention sustainability in one or more of their variations or that explicitly refer to one or more of the SDGs or their related targets, but also of other competencies that are SDG-related and that would require only minor changes in their descriptions. The subsystem called Types of competency examines the number of competencies in the curriculum distributed by type, potential problems of organisation such as the repetition of supposedly different competencies, and their distribution by subject. The third subsystem, Cognitive processes, studies the cognitive processes that can be deduced from the description of the competencies in order to analyse the conceptual coherence between curriculum and the intended graduate profile of degree programme. While the first subsystem focuses on the level of introduction of an education for sustainability, the other two subsystems seek to identify any issues that may negatively affect curriculum in terms of their organisation and conceptualisation of the competencies. These issues that need to be resolved in order to conduct subsequent revisions of the curriculum are specifically aligned to sustainability.

The study has given special attention to ensuring that the names of the categories are easy to understand and can be used by teachers who have no experience in qualitative analysis. That said, their use does require a basic understanding of some qualitative data

analysis computer software, which could be ensured with a half-day training session. The alternative would be for the university to integrate the proposed system as an SDG inventory module in the currently available online curriculum system, which organises competencies by degree, subject and academic year. Similar to the approach described by Ya-Ching and Hsing-Lung [24] or Consorte-McCrea et al. [22], the idea is for teachers to code the competencies associated with the subjects that they teach during the period allocated for their preparation of the upcoming academic year. It would provide a great deal of valuable information to monitor the process of implementing an education for sustainability. As the empirical study has shown, a mean value of 9.29 competencies per subject would not involve a significant workload; and the workload would be even less onerous, when the task is carried out only once a year and when most subjects draw on the involvement of more than one teacher. For the correct performance of this activity, it would be necessary to include a degree-specific half-day training module in the official schedule of training for university faculty, adopting the format of calibration sessions to ensure that teachers code accurately.

4.2. Empirical Study

4.2.1. Research Question #1: The Current Level of Implementation of the SDGs

The pilot study analysed the official master's degree programme in Advanced Studies in the History of Art in all public universities that have offered this degree in Spain during the academic year 2024–2025. The low level of implementation of the SDGs is corroborated in Table 4: (a) only 0.92% of competency codes reflected an explicit link to the SDGs and these appeared in only one subject in a single university; (b) only 13.25% of competency codes showed a certain affinity with the SDGs which accounted for only 2.20% of the total of different competencies; (c) two of the five studied universities presented no related competencies and a third presented some but only with serious problems of classification and (d) the subjects that showed an explicit alignment or certain affinity with the SDGs represented 1.22% and 53.66% of the total, respectively.

The obtained number of subjects connected to the SDGs was greater than the number found by Brugmann et al. [26] in undergraduate courses at the University of Toronto (25%), which appears in the upper quartile of Canadian higher education institutions; and it was higher than the results obtained by Orlovic Lovren et al. [30], who put forward a range of 13.16–21.21% for three faculties in the University of Belgrade. However, the two studies refer to academic years that were somewhat earlier than the period covered by the present study. However, even studies yielding better results show how much is left to do before achieving full implementation of the SDGs. For instance, at National University of Kaohsiung in Taiwan, the number of subjects varied between a minimum of 51% of subjects in the spring semester of 2019 and a maximum of 65% in the fall semester of 2019 [24]. Also, in their study of six of the 15 schools at the University of Melbourne, Rajabifard et al. [32] observed that the subjects connected to at least one of the SDGs fluctuated in the different schools between 27.4% and 77.8%. Sánchez-Carracedo et al. [33] examined seven Spanish universities and found that the average of subjects developing sustainability per university stood at between 11.11% and 80%, with a median of 44.44%. By contrast, Gómez-Martín et al. [29] concluded that 75% of subjects in the bachelor's degree in Civil Engineering at the Universitat Politècnica de València (Spain) for the academic year 2019–2020 had the potential to address some of the targets associated with the SDGs.

Since 53.66% of the subjects in the present study showed some affinities with the SDGs, we can infer that a more deep-seated implementation is possible, provided that minor changes are introduced into the description of competencies so that they may be recoded as Aligned.

4.2.2. Research Question #2: Issues Relating to the Distribution of Competencies

Analysing the organisation of competencies in the curriculum is useful primarily to understand the breadth and intensity of their treatment, but also to identify any problems in the competency map that could undermine the implementation of the SDGs. There are clearly problems of definition and organisation since 9.69% of total competencies have no reference to type (Table 5). This first impression is corroborated by the presence of a high number of apparently different coded competencies with an uneven distribution among the different universities: from 57 at UCM to 130 at UNIZAR. And this despite the fact that the evaluation agencies recommend limiting the number of competencies [54]. The existence of excessive lists of competencies has been the subject of repeated criticism in higher education [55,56]. It constitutes a phenomenon of competency inflation [57] associated with a more extensive problem that has been given a number of different names–e.g., curriculum overload, curriculum overcrowding and curriculum expansion–and that refer, in response to the new demands of regulatory bodies, to an accumulation of content that is not accompanied by curriculum reorganisation [58].

This trend can take the shape of adding new content to existing subjects, incorporating new subjects, or increasing the number of competencies. All of these options point to serious problems of curriculum design because they undermine the coherence of its structure and impeded its fulfilment. An imbalance in favour of the breadth of learning objectives over the depth with which they are addressed comes at the expense of a mobilisation of high-level cognitive processes [59]. The matter becomes even clearer if we consider that three of the five universities in the study have a competency repetition rate above 50% (Table 5). With impact levels of 84.09%, the case of competencies that were not organised according to the established types should be confronted in the first instance. Such excess is also observed in the distribution of competencies across subjects, as can be seen from an average of 9.29 competencies per subject and mean values greater than 10 in three of the five universities. As for the number of subjects that address each competency, a general mode of 1 and 4, together with the fact that three of the five universities present modes of less than 3 subjects (Table 5), confirm that there is an inversely proportional relationship between the breadth and the intensity of the competencies. In these circumstances, it is not feasible for the curriculum to include new competencies related to the SDGs, particularly when some examples of good practices for universities show overall averages below three SDGs per subject [24].

Examining the cognitive processes associated with the competency map offers another indicator of the intensity with which the competencies are handled in the curriculum. As Table 6 shows, only 26.12% of the general total of coded competencies refer to high-level cognitive processes in Anderson and Krathwohl's taxonomy, contrary to what is desirable in any university degree programme. The predominance of low-level cognitive processes arises in all types of competency but it reaches a high point in specific competencies, which account for 65.14% of coded references. This state of affairs would appear to be even more paradoxical in the case of a master's programme, which should have greater specialisation and depth. The above results concur with the results obtained in the study conducted by Sánchez-Carracedo et al. [33], although the latter authors compared their competencies to a simplified version of Miller's pyramid taxonomy. The sustainability competencies assume an understanding of the interconnection between social, environmental, economic and cultural aspects in order to be able to take part, together with relevant stakeholders, in the proposal and resolution of challenges relating to the management of resources without compromising the opportunities of future generations. According to Takala and Korhonen-Yrjänheikki [60], the sustainability competencies encompass holistic understanding, communication, collaborative skills, critical thinking, reflection, creativ-

ity, innovation and entrepreneurship. For their proper conceptualisation, therefore, it is impossible to develop such competencies in students only by means of low-level cognitive challenges. Moreover, evaluating the implementation of the SDGs requires making comparisons with external standards relating to an education for sustainability, such as the eight key competencies for sustainability (KCSs) promoted by UNESCO [4] or, in Spain, the four sustainability competencies approved by the Conference of Rectors of Spanish Universities [14]. Common to these examples is that the mentioned competencies include high-level cognitive processes and similarly high levels on the affective dimension [61]. This is, for example, the case of the critical contextualisation of sustainability knowledge, the prevention of negative impacts in the use of resources, the promotion of sustainability in community processes, and the application of ethical principles relating to sustainability.

4.2.3. Research Question #3: Steps to Promote the Implementation of the SDGs

The implementation of the SDGs calls for a complete reformulation of curricula. To this end, it will be necessary to promote initiatives to raise awareness and build commitment among teaching staff. One initiative of this sort would be to tackle problems that are easy to identity and quick to solve. In the present study, for example, errors in the classification of competencies affected roughly 10% of the total. Also, practically 20% of the competencies had an incorrect definition because the associated cognitive processes were missing.

With respect to introducing the paradigm of an education for sustainability, the first step would be to identify and review all competencies that are not aligned with the SDGs, but that do have affinities with their semantic field. Although they did not reach 15% of the total in the present study and they did not appear in all of the universities, their affinity with the SDGs would facilitate their conceptual review and, in this respect, prepare teachers for the more difficult task that would involve the reformulation of a significant number of competencies that have no relationship to sustainability.

Given the inherent complexity of sustainability competencies, it is important to introduce high-level cognitive processes so that they are predominant in any degree programme. The results of the present study showed that nearly 75% of coded competencies involved low-level cognitive processes on the Anderson and Krathwohl's taxonomy [51], which is not desirable in a bachelor's degree and even less so in a master's degree. Solving this problem is difficult because it involves redefining the conceptual core of competencies and educational practice, but it is also unavoidable because it is a key factor in the quality of learning related to sustainability. In effect, the predominance of high-level cognitive processes is a determining factor of the intensity with which the SDGs are treated in a degree programme. Without making these adjustments, it will not be possible to provide students with educational experiences that enable them to face the challenges that the society of today and the future will pose in relation to the social, economic, environmental and cultural management of resources.

The reconceptualisation of competencies must also come with a review of their organisation in the competency map. Efficacy and efficiency in curriculum design require that each of the defined competencies are actually different. Unnecessary repetitions are a risk when the design is the result of engagement from many stakeholders and when the aim is to link the competencies closely with each of the subjects that incorporate them in course syllabuses. The present study found that the degree of repetition of supposedly different competencies exceeds 48%, not only pointing to the magnitude of the error but also showing a simple way to minimise the serious problem of replacing an intensive treatment of competencies with an extensive treatment. The implementation of the SDGs must primarily be the result of modifying current competencies, but an appropriate clean-up of the competency map opens up an opportunity to introduce new competencies relating

to an aspect of sustainability that may have special relevance for the degree programme in question.

Reducing the number of competencies is key for the competency map to have the appropriate breadth and intensity. Curriculum design needs to take into consideration the number, type and definition of competencies to ensure fulfilment of the respective graduate profile, and that the number is distributed in an effective and practicable manner across the subjects as a whole. As noted earlier, there is an inversely proportional relationship between competency breadth and intensity, and it is necessary to strike a balance between the two factors because both too few and too many competencies prevent students from building the knowledge, skills and attitudes needed for personal, social and professional fulfilment. To achieve this goal, it is important not only to identify the core competencies but also to describe them clearly, limit their number, and ensure that their distribution across subjects is operational, as well as to organise them into performance levels that reflect increasingly higher demands. The present study shows that the first steps are yet to be taken: together with reconceptualisation of the competencies, the average of nearly 10 competencies per subject points to an urgent need to reduce their number. Once such a reduction has been achieved, it will be possible to increase their presence in subjects in order to achieve modes above 1. We could venture to say that a mode of 4 is the minimum number of subjects in which to programme a competency in order to introduce a gradual increase in the intensity of its treatment, while reserving at least two subjects for the advanced level.

5. Limitations and Future Research

The present study has a number of limitations. The first limitation is that the study analyses only how the competency map is enshrined in the course syllabuses and their connections to the SDGs. Given that the study did not examine thematic content, teaching methods and activities, or the learning evaluation system in course syllabuses, it is not possible to draw conclusions about how the sustainability competencies are treated in the classroom. Future research should examine the remaining sections of the course syllabuses. This examination should be complemented by an analysis of the teacher-specific syllabuses and information obtained from the teachers who teach the courses using other qualitative research techniques: in-depth interviews for courses taught by a single teacher, and focus groups for courses taught by several teachers. It is possible, though, to draw conclusions about the level of implementation of an education for sustainability at the heart of the curriculum design–whether in terms of its competencies or its learning outcomes–and to identify potential obstacles. This, after all, was the aim of the study: to take a snapshot of the actual coverage of sustainability, particularly given that course syllabuses are documents of normative value in the Spanish university system and available for public access.

The second limitation is that the study does not provide a detailed examination of the aligned or related competencies for each of the 17 SDGs in order to examine their relative weight in the competency map, nor does it go into detail regarding the extent to which each of the competencies is developed or whether it is developed correctly. The structure of the categories in the system called Presence of the SDGs yields necessary data. Given the scant implementation of sustainability competencies, however, this line of analysis has been relegated to a secondary position in the present study. A future publication could try to determine which of the 17 SDGs predominate in the master's degree studied and whether there are statistically significant differences between the five universities that offer it. This would allow us to identify the level of specialisation of a master's degree with respect to the challenges posed by the 2030 Agenda and the treatment given to the social, economic, environmental, and cultural dimensions inherent to the SDGs. Furthermore, examining the distribution and specific weight of each of the aligned or related competencies in the

master's degree would allow us to assess its fit inside with the curriculum design revealed in the previous aspect.

The third limitation is that the study did not examine many other issues that could have an effect on the conceptualisation and organisation of competencies. In fact, there are other aspects that have a direct impact on how these competencies are perceived by students and how the construction of the necessary learning is fostered. A future publication should address imbalances relating to the duplication or subordination of competencies, their alignment with other aspects that are defined by the teaching environment—e.g., the learning objectives, methodologies and evaluation, grammar, particularly complex wording, and the use of gender-inclusive language. The proposed model includes the Problem system to address these matters and has enabled us to compile the necessary data, but the need to reduce the length of the present paper has impeded their treatment.

6. Conclusions

The present study coincides with conclusions reached by other similar research studies. For instance, while progress has been made in the implementation of the SDGs in higher education, there remains a need for greater recognition and commitment, additional training and more resources for their implementation to reach a satisfactory level [1–4,15–17]. The issue directly concerns universities, as can be seen from the heterogeneity in the levels of implementation across degree programmes offered by a single university. At the same time, the issue also concerns national university systems because the same disparity can be observed across universities in a single country.

A growing number of studies argue for the need to introduce the SDGs into competencies or learning outcomes because these elements make up the core of curricula [9,11]. The present analysis underscores the fact that the gradual implementation of sustainability calls for reconceptualisation and reorganisation of the curriculum map, but also that implementation can be seized on as an opportunity to address the issues that affect current competencies. There is no denying that these challenges require an effort from teaching staff, without whose involvement none of the preceding steps will be achieved. Hence the importance of establishing strategies and providing tools to organise and facilitate the effort. Our study sets out a model that contains four category systems, focuses on examining how competencies are enshrined in course syllabuses, requires only a minimum understanding of qualitative analysis, and is intended specifically for degree programmes that are still at the start of the implementation process. Ultimately, the aim is to build commitment among teaching staff to incorporate the SDGs in their subjects and thereby distribute the work in an equitable manner while also reducing their workload as much as possible.

Several organisations have recently highlighted the need to accelerate the implementation process of the SDGs in university degrees in different countries so as to comply with the deadlines established in the 2030 Agenda [62–64]. Given this urgency, the proposed model could be of interest internationally, given its ease of implementation. In addition, empirical studies have shown that the categories that make up the model address aspects that affect competencies in the Spanish university system. Similar problems could also arise in the competencies or learning outcomes in other national systems. Furthermore, the categories established in the model could be a good starting point for other types of analysis. For example, in multi-criteria decision-making techniques such as the Analytic Hierarchy Process applied to the SDGs in higher education institutions [65,66], the categories could help to determine the decision goal and criteria, and thus to move on to the subsequent stages in this method.

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Abbreviations

The following abbreviations are used in this manuscript:

UB	University of Barcelona
UCM	Complutense University of Madrid
UNIZAR	University of Zaragoza
UOV	University of Oviedo
USAL	University of Salamanca

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