Multiple case-study analysis of service-learning as a means to foster sustainability competencies amongst pre-service educators

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Abstract

The aim of this multiple case-study analysis was to find out the influence that service-learning methodology has on the development of sustainability competences amongst university students (Preschool, Primary and Social Education) of three Spanish Universities (UIC, UAM and USAL). A sample of 129 university students of the academic year 2017-18 was used. A pre-experimental study was carried out, using a pretest-posttest study with natural groups, without a control group. The findings of this study show that service-learning contributed to improve knowledge in sustainability in the 5 case studies analysed. The findings also demonstrate how the use of service-learning promotes the development of practical skills associated with sustainability action.

Keywords: Service-learning, Education for Sustainable Development (ESD), Competencies, Students, Sustainability, Higher Education

1. Introduction

In the year 2000, driven by the need for more sustainable development in society, leaders of the United Nations member states signed an agreement to endorse the Millennium Development Goals (MDGs: UN, 2000), eight objectives related to human development to be met by the year 2015. The agreement generated worldwide mobilisation on an unprecedented scale. According to the final report (UN, 2015a), by the end of the MDG period, millions of lives had been saved and living conditions had

been improved for countless individuals thanks to this initiative. However, several major issues persist, from gender inequality to poverty and hunger, to climate change, environmental degradation, and major armed conflicts. In view of this, in 2015 the United Nations passed the 2030 Agenda in the hope of prolonging the impact of the MDGs. The Agenda is comprised of 17 Sustainable Development Goals (SDGs: UN, 2015b), integrated in such a way that they combine the three dimensions of sustainability: economic, social and environmental (Lozano, 2008).

The United Nations Decade of Education for Sustainable Development 2005-2014 (DESD) was announced through a resolution that addressed the need to adopt a global perspective when facing environmental issues. The resolution also called for education to be more accessible, and to be redirected so as to promote lifestyles that better society and promote a more sustainable future (UNESCO, 2005).

The 2030 Agenda for Sustainable Development results from the need to integrate the principles of DESD with the aim of planning specific sustainable initiatives that, by aiding the acquisition of certain skills, would allow individuals to reflect on their actions and their social, cultural, economic, and environmental impact at the local and global scale (Cebrián & Junyent, 2015; UNESCO, 2017).

From this context, the EDINSOST project (Education and Social Innovation for Sustainability in Spain) emerged, funded by the Ministry of Economy, Industry and Competitiveness (2015), involving a total of 10 Spanish universities (UAM, UCA, UCJC, UCO, GII, UIC, UPC, UPM, US and USAL) (Sánchez, Segalàs, Vidal, Martin, Climent et al., 2018). Its primary objective was to promote educational innovation to integrate sustainable development into these universities. This general objective covers the more specific aim of establishing strategies for the acquisition of competences in sustainability from multiple viewpoints: pedagogical, constructivist and communal. In

this paper, the results of a multiple-case study evaluating the influence of service-learning methodology are explored, assessing the implementation of these competencies in sustainability in teacher training degrees (preschool, primary, and social education) at three Spanish universities (UIC, UAM, and USAL). A previous statistical analysis of the initial level of sustainability competence among students was conducted, which included an exploration of these according to the year of study of university students (1st, 2nd, 3rd and 4th), and the variables gender and age. Moreover, a pretest-posttest design was applied, using non-equivalent groups (without a control group) in order to assess the development of competencies in sustainability among students in five cases (based on subject studied), where the service-learning teaching method was implemented.

2. Theoretical framework

2.1. Sustainability competencies

Incorporating the SDGs into higher education means ensuring that the students develop various competencies in sustainability, such as critical thinking, systemic thinking, anticipatory thinking, ethics and values, and interpersonal skills (Cebrián, Segalàs & Hernández, 2019; Rieckmann, 2012; Wiek, Withycombe, & Redman, 2011). Therefore, the successful incorporation of these goals into education systems calls for ESD-inspired modifications to teaching methods, such as learning from real-world problems, anticipating and preparing for future challenges (Albareda, Vidal & Fernández, 2018; Segalàs, Ferrer-Balas & Mulder, 2010), and developing educational practices that incorporate various disciplines, cultures, and perspectives (UNECE, 2012). Integrating these goals has proved successful in many Spanish universities, as demonstrated by several articles published in recent years (Fernández, Alférez, Vidal, Fernández &

Albareda, 2016; Barrón, Navarrete & Ferrer-Balas, 2010). In this context, special attention needs to be paid to initial teacher training, as teacher students are those that, through their teaching activity will contribute to the training of future professionals (Bürgener and Barth, 2018; Cebrián & Junyent, 2015; UNECE, 2012; UNESCO, 2017).

Over the last decade, there have been many studies on the conceptualisation and definition of competencies in sustainability in higher education (Lozano et al., 2017; Mochizuki & Fadeeva, 2010; UNESCO, 2017; Wiek, Withycombe & Redman, 2011). However, few published studies focus on the assessment of sustainability competencies, and the application and evaluation of the impact that concrete methodological tools have in the development of these amongst university students studying any degree (Cebrián, Segalàs & Hernández, 2019; Fuertes & Albareda, 2014; Wiek *et al.*, 2016).

One of the reasons for this lies in the difficulty involved in evaluating this area and, by extension, registering data that would prove the development of these competences following the implementation of different teaching strategies (Lozano *et al.,* 2017; Medir, Heras & Magin, 2016). There is still further research to be conducted to implement innovative and transformative teaching and learning approaches and transformative institutional strategies that lead to sustainability competencies (Barth & Rieckmann, 2016; Sterling, Glasser, Rieckmann & Warwick, 2017). Therefore, as stated by Wiek et al. (2016) the research agenda in the following years needs to focus on operationalising sustainability competencies, framing the different levels of competence and measuring and evaluating students' competencies development.

As previously explained, integrating sustainability into education implies a paradigm shift in teaching processes, and an awareness of certain aspects such as: replacing a static, fragmented view of reality with a complete, dynamic vision; promoting systemic and relative thinking, improving the contextualisation of teaching processes, organising

practical work in line with the proposed theories, and adopting a mindset based on constructivist epistemology and integral understanding of education (Barrón, Navarrete & Ferrer-Balas, 2010; Sterling, 2004). This paradigm shift becomes particularly relevant when it comes to the teacher's training, since they will be the ones to impact how future professionals are trained; this is our focus when we refer to Competences in Education for Sustainable Development (UNECE, 2012; Ull, 2015; Cebrián & Junyent, 2015).

In 2000, the Conference for the Rectors of Universities in Spain (Spanish: *Conferencia de Rectores para las Universidades Españolas*; CRUE) formed a working group for Environmental Quality and Sustainable Development (Spanish: *Calidad Ambiental y Desarrollo Sostenible*; CADEP), its aim being to promote the integration of standards for sustainability in universities, and to encourage inter-university cooperation in this area. In 2012, the group's Executive Committee approved a document detailing guidelines and suggestions for a curriculum with a greater focus on sustainability, now titled *CRUE-Sustainability* (CRUE, 2012). The document establishes four sustainability competencies (SC), SC1-SC4 (Table 1), allowing the curricula of the main Spanish universities to be revised and integrated with these.

Table 1. *Sustainability Competencies defined by CRUE-Sustainability (CRUE, 2012)*

Sustainability Competence (SC)	Definition
SC1	Competence in the critical contextualisation of knowledge through establishing links between social, economic and environmental issues on a local and/or global level.
SC2	Competence in the sustainable use of resources and in the prevention of negative impacts on natural and social environments.

SC3	Competence to actively participate in community processes that promote sustainability.
SC4	Competence to apply ethical principles related to sustainability values in personal and professional behaviour.

Based on these four competencies, EDINSOST's research group created a sustainability competencies framework applicable to education degrees (preschool, primary, social education, and pedagogy), which can be considered competences in education for sustainability (Albareda, Vidal, Pujol & Fernández, 2018). The framework breaks these competencies down into competence units and defines 3 levels of knowledge and their acquisition, which was created to unify skills and provide a point of reference for developing rubrics or tools to evaluate these competences (Table 2). This framework was elaborated by a team of nine researchers - experts in EDS - members of the EDINSOST project, through an iterative process of definition and validation of competence units and acquisition levels for each competence (table 2). Three levels of mastery – competence acquisition were established according to Miller's simplified pyramid (1990): Knows (referring to the acquisition of concepts); Knows How (referred to practical skills); Shows How (confrontation with the demonstration in the action and its transferability to real situations).

Table 2. *Sustainability competencies framework for education university degrees (adapted from Albareda et al., 2018).*

SUSTAINABILITY COMPETENCE (SC)	COMPETENCE UNITS (CU)	ACQUISITION LEVELS (AL)		
		AL 1. KNOWS	**AL 2. KNOWS HOW**	**AL 3. SHOWS HOW**
SC1	CU 1.1. Understands how natural, social and economic systems function and the mutual interrelations between them, as well as the problems related to them, both locally and globally.	Knows the functioining of natural, social and economic systems, and their interrelationships.	Analyses and understands the relationships between natural, social and economic systems.	Is able to imagine and foresee the repercussions of changes in a natural system, on social and economic systems.
	CU 1.2. Owns critical reflection and creativity, taking advantage of the different opportunities presented (ICT, strategic plans, regulations, etc.) in planning a sustainable future be.	Knows the opportunities that ICT, regulations and strategic plans for an innovative and creative sustainable planning.	Understands and reflects, in a critical and creative way, on the opportunities that are presented from the use of ICT and innovation in order to plan in a sustainable manner.	Creates and provides sustainable solutions in educational projects from a critical and creative perspective, improving sustainable planning and action.
SC2	CU 2.1. Designs and develops actions, making decisions that take into account the environmental, economic, social, cultural, and educational impacts to improve sustainability.	Knows the basic concepts to approach the design, development and evaluation of educational actions taking into account their environmental, social, economic and cultural repercussions.	Recognises and integrates the importance of designing educational actions having into account sustainability criteria, and considering the need to evaluate the effects that the implementation of these actions could have.	Designs and implements educational actions in which sustainable practices are included and proposes adequate and coherent evaluation mechanisms.
SC3	CU 3.1. Promotes and collaborates in socio-educational actions as part of a cooperative community, including the participation of different stakeholders and co-responsibility with sustainability issues.	Recognises itself as an integral part of the environment and identifies the subjects and entities of the community, their roles and antecedents, as well as the systemic interactions that take place between them.	It develops efficiently within groups, in which promotes educational projects for the systemic analysis of the environment, putting in practice methodologies and techniques for the analysis of social and participatory community processes.	Is capable of promoting, designing and executing collaborative action projects aimed at improving participation and environmental democracy in the educational and social space.
SC4	CU 4.1. Is consistent in taking actions, respecting and valuing diversity (biological, social and cultural) and commits itself to the improvement of sustainability.	Knows the ethical principles related to diversity, sustainability, social justice and human development. Identifies the essence of a conscious and respectful education: limits, freedom, conflict, active risks, work contracts, autonomous learning, etc.	Integrates the ethical principles of sustainability in its actions, considering nature as a good, conveying the importance of education for change in the relationship of the human beings and the environment.	Takes ethical decisions in the personal and professional environment, considering social justice and the common good, generating dynamics of human development in the educational activities that are researched, designed and executed.
	CU 4.2. Promotes a values oriented education towards the training of a responsible, active and democratic citizenship.	Recognises and presents the ethical principles and values of social justice and sustainable human development as a fundamental part of the formation of citizenship.	Reflects on the consequences of its personal and professional intervention, analyses them from an ethical perspective and is able to critically assess their consequences.	Promotes and coordinates ethical educational actions capable of embedding the values of sustainability, and which result in justice and the common good.

2.2.Service-learning to develop sustainability competencies

The Spanish Ministry of Education's University Strategy for 2015 highlights the importance of social engagement, and the development of a university programme that meets the values of quality and adequacy to the social context, according to the European framework. In addition, the improvement of these universities' capacity to aid the country's social needs is addressed (González-Geraldo, Jover, & Martínez, 2017; Straková & Cimermanová, 2018). CRUE (2017) believes that universities should assume a leading role in human development, exploring and implementing new strategies designed to construct a fairer and more inclusive society. For this reason, once the report on sustainability in Spanish universities was developed, the CADEP working group approved a technical document establishing service-learning as a teaching strategy within the framework of the Social Responsibility of Universities policy to promote sustainability in universities (CRUE- CADEP, 2015).

Service-learning is an experiential teaching method which allows students to learn, develop, and demonstrate skills through real-world experiences, aided by the organisation and implementation of educational projects that respond to the genuine needs of their particular social context (Barth et al., 2014; Jover & García, 2015; Mochizuki & Fadeeva, 2010). The learning process becomes incorporated into services for the community which, in turn, fosters academic and moral development through social action (Exley, 2004; Nucci & Narvaez, 2008). Its implementation requires active student participation and coordination between the collaborating institutions. The aim of this is to combine the learning objectives with socially conscious goals that favour the social, academic, and personal development of the students who discover how to undertake ethical actions that benefit their community (González-Geraldo et al., 2017). The methodology used allows students to get involved in their immediate social

contexts, adapting to needs therein, and to a reality that can often be very different from that experienced in the classroom (Folgueiras, Luna & Puig, 2011).

The term 'service-learning'—also referred to as 'community-based learning' or 'learning through community engagement' (McIlrath et al., 2016) — was first coined in 1967 by Sigmon and Ramsey (Giles & Eyler, 1994), and the first proponents of service-learning were pedagogically supported by the field of experiential education (Dewey, 2016). To ensure that the community service have a significant effect on learning processes, they sought to link the students' experiences with the critical thinking and analytical skills set out in the curriculum. They observed the importance of the students being in close contact with complex, contemporary social problems, and noted their efforts to resolve these issues as essential to a comprehensive education (Crews, 2002). There are two main reasons to implement service-learning programmes in universities: to mobilise youth and teach them the importance of giving and receiving, and to connect the university with educational issues off campus (Caspersz & Olaru, 2017; Puig, 2011).

From this perspective, it can be an effective strategy for the inclusion of sustainability in university curricula (Billig & Welch, 2004; Billig, Root, & Jesse, 2005). The focus is similar to the concept of 'Social Responsibility in Universities' that was included in the Ministry of Education's University Strategy for 2015 and also the guidelines adopted by the CRUE. As a teaching method, its strength lies in its potential for social transformation. (Aramburuzabala, Hernandez-Castilla, & Ángel- Uribe, 2013; Aramburuzabala, 2013; Barth et al., 2014). Moreover, it complies with current university regulations which require that universities encourage social and civic responsibility, combining academic teaching methods in different subject areas with the provision of services to the community, aimed at developing critical thought to improve

quality of life and promote social inclusion (Baldwin, 2016; Clifford, 2017; Chee-Choy, Sau-Ching & Leong-Tan, 2017).

Through the creation of specific frameworks, service-learning methodology is implemented in higher education the world over and has been established as a standard educational practice (Furco & Miller, 2009). There are numerous service-learning experiences available at universities that incorporate exercises in social responsibility and also allow students to develop an entrepreneurial spirit (Aramburuzabala, 2013, Celio, Durlak, & Dymnicki, 2011, Enos, 2015). At the same time, these national and international models have accelerated development of the methodology in recent years, in both public and private universities. In addition, there are currently a large number of universities in the national and regional service-learning network.

Within the EDINSOST project framework, this paper is an empirical study of the implementation of the service-learning teaching strategy in preschool education, primary education and social education degrees across three Spanish universities (UIC, USAM, and USAL) aiming to develop students' competencies in sustainability.

3. The Method

3.1. The Sample

The initial sample of 319 participants selected via intentional nonprobability sampling was eventually reduced to 129 university students for the academic year 2017-18 in the pretest-posttest (due to the group's high dropout rate). The students were enrolled in the following bachelor degrees: Preschool Education, Primary Education and Social Education at the International University of Catalonia (UIC), the Autonomous University of Madrid (UAM) and the University of Salamanca (USAL). The

participants were categorised into five case studies where the service-learning teaching strategy was implemented, as shown in Table 3.

Table 3. *Sample distribution by case studies and universities.*

Case	University	University degree	Subject	n pretest	n posttest
1	UIC	Primary Education	Teaching and learning experimental sciences III	26	24
2	UIC	Primary Education	Teaching and learning experimental sciences II	21	24
3	UAM	Preschool Education	Psychopedagogical basis for the inclusion of students with specific needs	26	21
4	UAM	Primary Education	Theory and politics of education	225	34
5	USAL	Social Education	Socioenvironmental education	21	26
			Σ	319	129

Regarding the classification of academic subjects included in the study, it is important to note that case studies 1, 2, 3 and 4 are compulsory subjects to be taken in the 1st year (case study 4), in the 2nd year (case studies 2 and 3) and in the 3rd year of the degree (case study 1). Subject 1 combines theoretical knowledge with the development of practical and procedural skills, including physics, chemistry, and one unit containing specific content on Education for Sustainable Development (ESD) and the dynamics of the earth. On this course, students conducted a service-learning project with students from the Escola Fàsia in Barcelona, a centre for children with learning difficulties located in the Sarrià-Sant Gervasi district. Following an agreement between the city of Barcelona and the International University of Catalonia (UIC), UIC students used the district's communal allotments to do gardening work with children from the Escola

Fàsia, moving them from their regular learning space to the outdoors. There, they could develop their dexterity and cultivate the plants by working together as a team.

Subject 2, Teaching and Learning in Experimental Sciences II, concerns the biosphere, people and health. For this subject the service-learning project took place at the communication workshop *Taller Comunica*. This workshop was formed a response to appeals from various education centres in the Vallès Occidental, and through an agreement with the Sant Cugat municipality. The aim was to help improve their secondary school students' communication skills in preparation for the oral presentation and defense of their final research project. UIC students travelled to the centres to hold the three sessions that comprised this workshop. The contents of these sessions were academically linked to the university students' subject (Teaching and Learning in Experimental Sciences II) as the secondary school pupils' presentations revolved around the impact of consumer habits on the planet and our individual ecological footprint.

Subjects 3 and 4, at the Universidad Autónoma de Madrid (UAM), comprise a specific university-level, service-learning educational programme, where students carry out a service-learning project with collaborating institutions, such as the Women's Space and the Spanish Red Cross Youth. Examples of service-learning projects include: reforestation and environmental awareness in educational settings, imparting core values; early child care and educational support; recreational and educational activities in third sector organisations; the support and promotion of academic success; and the provision of companionship and recreational activities in healthcare facilities.

Subject 5 is the University of Salamanca's (USAL) course on socio-environmental education, an optional subject taken in the 4th year of the degree. This course content is focused on environmental education and its conceptual and methodological bases. Here,

students undertake service-learning projects with social and ecological organisations from the local area.

3.2. Research process and technique

Regarding the methodology, from a quantitative viewpoint, a pretest-posttest design with non-equivalent groups was used. There was no control group, and participants took part on a voluntary, confidential and anonymous basis. Thus, the process essentially consisted of three steps: firstly, an evaluation of the students' sustainability competencies across the five case studies took place; secondly, the learning method was carried out (educational intervention through the service-learning methodology, and student participation in service-learning projects in collaboration with social and environmental organizations and institutions); and finally, following completion of the courses, the posttest evaluation took place, revealing the progression and ultimate result of the study.

The research technique consisted of a specific questionnaire consisting of 18 items used to analyse the students' development of sustainability competencies. As previously discussed, this study is part of the broader EDINSOST research project. The framework of sustainability competencies of education degrees, consisting of 6 competence units (CU) and 3 acquisition levels (AC) (see Table 2) was used as the basis for the design of the questionnaire, resulting in a 18-item questionnaire: SC1 items 1-6, SC2 items 7-9, SC3 items 10-12, SC4 items 13-18, Knows items 1, 4, 7, 10, 13 and 16, Knows How items 2, 5, 8, 11, 14 and 17, and Shows How items 3, 6, 9, 12, 15 and 18.

A four-level Likert scale was used (1 "strongly disagree", 2 "disagree", 3 "agree" and 4 "strongly agree"). Validation of the instrument was carried out by expert judgment,

researchers members of the EDINSOST project. The internal consistency of the estimated instrument, Cronbach's alpha, is 0.94, a satisfactory value with ranges between 0.82 and 0.89 for the four sustainability competences studied.

4. Results and Discussion

The previous analysis of the development of sustainability competencies in relation to the year of study (1st, 2nd, 3rd and 4th) showed differences in the same direction: statistically differences between 1st and 4th year of study, with higher values in the 4th year compared to 1st year students (Table 4). In relation to variables gender and age, no significant differences were found in the statistical analysis. Hence, the t-test for independent samples outlined in Table 4 focuses specifically on the comparison between the two groups that shown significant differences (Year 1 vs 4).

Table 4.

T-test results between Year of study 1 and 4

	t	N	p	Mean Difference	SE Difference
CU 1.1	-3,310	317	,001	-1,392	,420
CU 1.2	-1,659	317	,098	-,794	,478
SC1	-2,942	317	,004	-2,186	,743
SC2	-1,175	317	,241	-,514	,438
SC3	-,522	317	,602	-,218	,418
CU 4.1	-3,351	317	,001	-1,457	,435
CU 4.2	-1,976	317	,049	-,833	,422
SC4	-3,151	317	,002	-2,290	,727
AL1	-2,532	317	,012	-1,684	,665
AL2	-2,963	317	,003	-1,939	,654
AL3	-2,120	317	,035	-1,585	,748

As can be seen in Table 4, there are statistically higher scores in 4th year students, compared to those in 1st in SC 1 (p=.004), influenced by CU 1.1 (p=.001), and in SC 4 (p=.002) derived from its two competence units (CU 4.1 p=.001; CU 4.2 p=.049). In relation to the acquisition levels (AL) significant statistical differences between year 1 and year 4 were shown, AL 1 – Knows (p=.012), AL 2 – Knows how (p=.003) and AL 3 – Shows how (p=.035).

To answer the research questions, the results of the 129 participants who completed the pretest and posttest questionnaires across all five case studies were collected (described by the descriptive statistics in Table 5).

Table 5. *Descriptive statistics of competencies, competence units (CU) and acquisition levels (AC) per case study*

		SC 1	CU 1.1	CU 1.2	SC 2	SC 3	SC 4	CU 4.1	CU 4.2	AL 1	AL 2	AL 3
UIC - Case study 1												
Pre	X	8.23	8.69	9.08	9.12	9.62	18.73	17.77	9.38	18.58	18.04	17.50
	SD	1.66	1.44	1.23	1.53	1.33	2.49	1.99	1.20	1.98	2.03	2.23
Post	X	9.33	10.04	9.71	9.63	9.83	19.46	19.75	9.58	19.63	19.58	18.92
	SD	1.27	1.40	1.52	1.47	1.31	2.45	2.15	1.72	2.14	2.50	2.41
UIC - Case study 2												
Pre	X	7.14	7.10	7.90	7.81	8.57	16.38	15.00	8.05	16.10	15.33	15.14
	SD	1.56	1.30	2.07	1.60	1.66	2.77	2.28	1.72	1.97	2.39	2.97
Post	X	8.04	7.79	9.21	8.71	9.04	17.75	17.00	8.50	17.38	17.33	16.58
	SD	1.90	1.28	1.69	2.12	1.52	3.15	2.38	1.89	2.78	2.66	3.19
UAM - Case study 3												
Pre	X	8.42	8.08	8.04	8.08	9.58	17.65	16.12	8.62	16.88	17.00	16.92
	SD	1.90	2.15	1.99	2.35	1.96	3.96	3.72	1.86	3.55	3.22	3.57
Post	X	9.81	9.00	9.19	9.05	10.00	19.05	18.19	9.71	18.71	19.38	18.67
	SD	1.54	1.64	2.02	1.83	2.00	3.49	3.33	2.05	3.20	3.22	3.58

UAM - Case study 4												
Pre	X	8.06	7.59	7.47	7.53	8.66	16.19	15.06	8.02	15.90	15.96	15.47
	SD	1.69	1.67	1.91	1.77	1.70	2.91	2.94	1.76	2.62	2.61	2.97
Post	X	8.68	8.50	7.74	8.12	8.91	17.03	16.24	8.76	16.94	17.24	16.53
	SD	1.93	1.93	2.21	2.25	1.71	3.36	3.84	1.99	3.49	3.42	3.61
USAL - Case study 5												
Pre	X	8.00	6.57	6.90	6.76	8.00	14.76	13.48	7.10	14.52	14.81	14.00
	SD	2.02	1.86	1.51	2.12	2.02	3.91	2.98	2.05	3.31	2.87	3.15
Post	X	9.58	8.58	9.00	8.92	9.15	18.08	17.58	9.08	18.12	18.12	18.08
	SD	1.55	1.68	1.85	1.79	1.69	3.10	2.96	1.83	3.12	2.88	2.98

The data was analysed and contrasted using paired samples t-test (see Table 6) to analyse the effect of the service-learning methodology on the different case studies. It also compared the self-assessment in the development of sustainability competencies of students, with regard to the competencies, competency units, and acquisition levels of the sustainability competencies construct.

Table 6. *Summary of significance and effect size obtained on t tests for paired samples.*

	SC 1	CU 1.1	CU 1.2	SC 2	SC 3	SC 4	CU 4.1	CU 4.2	AL 1	AL 2	AL 3
UIC – Case study 1											
t	2.62**	3.36***	1.62	1.20	0.58	1.04	3.39***	0.48	1.80	2.41**	2.16***
d	0.74	0.95	0.45	0.33	0.15	0.29	0.95	0.17	0.50	0.67	0.61
gl	23	23	23	23	23	23	23	23	23	23	23
UIC – Case study 2											
t	1.72	1.80	2.32*	1.59	0.99	1.54	2.87***	0.84**	1.76	2.63**	1.56
d	0.51	0.53	0.88	0.42	0.29	0.46	0.85	0.24	0.53	0.79	0.46
gl	23	23	23	23	23	23	23	23	23	23	23
UAM – Case study 3											
t	2.70***	1.62	1.96	1.55	0.73	1.26	1.99	1.92	1.84	2.52**	1.66
d	0.80	0.48	0.72	0.46	0.21	0.37	0.58	0.55	0.54	0.73	0.48
gl	20	20	20	20	20	20	20	20	20	20	20
UAM – Case study 4											
t	1.94	2.90***	0.74	1.74	0.81	1.54	2.08*	2.26*	2.06*	2.53**	1.89
d	0.34	0.50	0.13	0.29	0.14	0.27	0.34	0.39	0.33	0.42	0.32
gl	33	33	33	33	33	33	33	33	33	33	33
USAL – Case study 5											
t	3.02***	3.88***	4.17***	3.79***	2.13***	3.24***	4.71***	3.50***	3.82***	3.92***	4.55***
d	0.87	1.13	1.24	1.10	0.61	0.96	1.38	1.01	1.11	1.15	1.33
gl	25	25	25	25	25	25	25	25	25	25	25

* The contrast is significant p<.05 (Bilateral)
** The contrast is significant p<.025 (Bilateral)
*** The contrast is significant p<.01 (Bilateral)

Firstly, focusing on the competencies from a holistic perspective, statistically significant differences can be found regarding SC 1 in case studies 1 ($t = 2.62$, $p < .025$), 3 ($t = 2.70$, $p < .01$) and 5 ($t = 3.02$, $p < .01$) with a considerable effect size $d<0.7$, and, on closer inspection, further differences can be found per the competency units in the other 2 cases, in the CU 1.2 of case study 2 ($t = 2.32$, $p < .05$, $d=0.88$) and in the CU 1.1 of case study 4 ($t = 290$, $p < .01$, $d=0.5$). Therefore, we can observe the influence of service-learning on the acquisition of the first competence (SC 1) across all five case studies. This can be linked to the contextualisation of knowledge and establishment of connections between the three dimensions of sustainability (social, environmental and financial) derived from students engagement in service-learning sustainability projects. As indicated by other studies (Cebrian & Junyent, 2015; Segalàs, Ferrer-Balas & Mulder, 2010) the course subjects that implement a pedagogical focus based on active learning, similar to service-learning, increase the students' knowledge on sustainability. The results obtained in this study are consistent with the evidence available in the literature, which indicates a positive impact of service-learning projects on sustainability in the application of theoretical knowledge in real situations and contexts (Barth *et al.*, 2014; Martínez & Folgueiras, 2015; Rodríguez-Gallego & Ordóñez-Sierra, 2015; Tejada, 2013).

However, generally speaking, in the remaining competences (SC 2, SC 3 and SC 4) no significant differences have been demonstrated, except for in the circumstances analysed below. Firstly, in competency SC 4, in the first level of competence units related to coherence and commitment to sustainability, statistically significant differences have been found in all cases, except in case study 3. This result may be explained by the diverse nature and content of the subjects studied. The subject of case study 3, ‘psychoeducational methods for the integration of special needs students’, has

the smallest focus on sustainability, which would imply a lesser impact on the development of these competencies. This result reinforces the idea that the impact or improvement in the development of competences in aspects related to the ethical dimension of sustainability, through the use of service-learning, is due to the diversity in nature and content of the subjects studied.

This result refers us to the importance of the topic or focus of service-learning projects, as an engine for the acquisition of ethical values and attitudes of social and environmental commitment. Other empirical studies corroborate the results of this research in relation to the impact of service-learning in the development of social and civic competencies, and ethical attitudes and values that promote sustainability (Lorenzo & Matallanes, 2013; Martínez & Folgueiras, 2015; Tejada, 2013). According to the existing literature, critical reflection and the application of knowledge to real and complex situations, inherent to service-learning methodology, promote self-awareness and questioning of values and beliefs, and the mobilisation of different types of knowledge in students (Bielefeldt, 2013; Giles & Eyler, 1994; Rodríguez-Gallego y Ordóñez-Sierra, 2015). Service-learning projects require that students have to holistically analyse and face the challenges associated with sustainability, which facilitates a further development of social learning, values and ethics.

Secondly, it should be noted that when analysing case study 5 (USAL) in detail, significant differences were found with high values in terms of effect size, across all competencies, units, acquisition levels and in 15 of the 18 items of the questionnaire, an optimal reality for this research. It is an optional subject with a focus on socio-environmental education, which evidently has a direct link to sustainability. The main objective is to aid in the development of these competencies. This result highlights the importance of including optional or specific subjects on sustainability in the curricula

(Hegarty et al., 2011), which use active methodologies such as service-learning, since it allows for the creation of educational spaces where knowledge, practical skills, and ethical principles can be acquired for a future professional practice orientated towards sustainability. The results of this research are in line with those obtained by Lasen *et al.* (2015), which also suggest that linking service-learning projects with specific subjects on sustainability, guided by the principles of equity and social justice, can more extensively validate the use and investment in service-learning projects and social commitment in higher education.

Finally, regarding the three levels of acquisition following Miller's pyramid (Miller, 1990), no change was observed in the first level (Knows), except in case study 4 ($t=2.06$, $p<0.05$, $d=0.33$) and case study 5 ($t=3.82$, $p<.01$, $d=0.95$).

This could be due to the typology of subjects in 4 and 5, eminently conceptual theoretical subjects. However, when it comes to the second level of acquisition - the application of skills (Knows how) - changes were found across the board, consistent with the use of active methodologies, like service-learning, which promote the development of practical skills, i.e. the application of knowledge to real-life situations (Barth et al., 2014). The results of this study are consistent with previous studies in the Education for Sustainable Development, which indicate the use of active methodologies (such as service-learning, cooperative and project-based learning and problem-solving) as key strategies for the development of sustainability competencies in students (Barrón, Navarrete & Ferrer-Balas, 2010; Lozano et al., 2017; Mindt & Rieckmann, 2017).

Lastly, regarding the third level of acquisition (Shows how) statistical significant differences were observed in case studies 1 ($t = 2.16$, $p <.01$, $d=0.61$) and 5 ($t = 4.55$, $p <.01$, $d=1.33$), a reality that endorses the initial hypothesis that subjects with a stronger

focus on action itself and on demonstrating ‘how’ promote the Shows how acquisition. This argument should also be applied to case study 2 where we see a tendency towards a higher average in posttest evaluations, despite no statistical significant differences were found due to a limited sample size.

5. Conclusions

In general, it has been established that service-learning has a significant impact on the acquisition of sustainability competencies. However, it is worth highlighting that the students studying optional subjects (case study 5) with a focus on sustainability scored higher than those studying compulsory subjects (case studies 1–4). This result can be attributed to the inclination and sensitivity towards sustainability, demonstrated by students studying specific, optional subjects on this topic.

Of the four competencies tested, the SC 1 competence scores most highly across all the case studies, revealing an increase in knowledge with regard to understanding and reflecting upon the links between the social, environmental, and economic dimensions of sustainability. Learning in real contexts where these links are present is key to comprehending sustainability (Lozano et al., 2017; Wiek et al., 2016).

Across the three levels of competence acquisition (Knows, Knows How, Shows how) service-learning is observed to have a greater impact on the Knows How level. This is attributed to the fact that the teaching methodology delves into the practice and application of theoretical knowledge in real socio-educational contexts.

It is also worth noting the limitations of this study, due to the sample’s high dropout rate and the pretest-posttest design with a lack of control group or the high mortality of the sample, especially in case study 4 - UAM, a fact that raised doubts about its inclusion in

the study, ultimately considering that 34 subjects with both measurements was a representative number to maintain this case.

In future studies, the possibility of conducing longitudinal studies and using mixed research methods has been raised, which would allow for a comparison of quantitative results with a qualitative evaluation of learning methods. The objective of this would be to gain an in-depth understanding, through analysis, of the methodology used when implementing service-learning in each case.

ESD implies promoting cognitive, socio-emotional and behavioral learning objectives (UNESCO, 2017). In order to evaluate these learnings it is necessary to use a variety of assessment tools such as reflective journals, interviews or discussion groups that allow students to consider the value they place on sustainability both personally and professionally (Bielefeldt, 2013; Vázquez, 2015). Therefore collecting qualitative data through studies, interviews, focus groups and daily reflection would provide information on how each student perceives their own progress, on how teaching activities and evaluations are carried out, and finally on how these activities facilitate the acquisition of competency in sustainability.

As for the curriculum, this research has shown that specific courses on sustainability have the greatest impact on the acquisition of competency in sustainability. The study has also demonstrated the need to holistically integrate these competencies into the curriculum, and the importance of including specific optional or compulsory subjects on sustainability, contextualised according to the students' subject area. These subjects provide the greatest opportunities for deepening our understanding of sustainability through specific reflection.

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