

Article

# Interdisciplinary Learning at University: Assessment of an Interdisciplinary Experience Based on the Case Study Methodology

Naiara Berasategi <sup>1</sup>, Igone Aróstegui <sup>1,\*</sup>, Joana Jaureguizar <sup>2</sup>, Alaitz Aizpurua <sup>3</sup>, Nagore Guerra <sup>4</sup> and Ana Arribillaga-Iriarte <sup>4</sup>

<sup>1</sup> Department of Didactic and School Organization, Faculty of Education of Bilbao, University of Basque Country, 48940 Leioa, Spain; naiara.berasategi@ehu.es

<sup>2</sup> Department of Psychology, Faculty of Education of Bilbao, University of Basque Country, 48940 Leioa, Spain; joana.jaureguizar@ehu.es

<sup>3</sup> Department of Psychology, Faculty of Psychology of San Sebastian, University of Basque Country, 20018 Donostia, Spain; alaitz.aizpurua@ehu.es

<sup>4</sup> Department of Educational Theory and History, Faculty of Education of Bilbao, University of Basque Country, 48940 Leioa, Spain; nagore.guerra@ehu.es (N.G.); ana.arribillaga@ehu.es (A.A.-I.)

\* Correspondence: igone.arostegui@ehu.es

Received: 10 August 2020; Accepted: 16 September 2020; Published: 18 September 2020



**Abstract:** In the current context, higher education faces the challenge of preparing future professionals to respond to society's increasingly complex problems. However, the search for solutions means adopting new ways of working that promote multidimensionality through collaboration and an interdisciplinary outlook. In this change of paradigm, universities should work on the development of sustainability education, promoting critical reflection and the necessary skills to generate a change in thinking and real practice for sustainability, through incorporation of methodologies that foster collaborative teaching and working. The main aim of the present study was to design, implement, and assess an experience based on the case study methodology, approached from an interdisciplinary perspective. By designing repeated pretest–posttest measures, we analyzed changes in learning skills linked to interdisciplinarity, such as collaborative work, participation, motivation, and interdisciplinary thinking. The sample comprised 539 university undergraduates from Social Education, Primary Education, and Psychology degree courses. The results confirmed that the methodology used improved interdisciplinary outlook, participation, cooperation, and motivation. The implications of this type of innovative experience for the teaching–learning process of university students are discussed.

**Keywords:** case study methodology; cooperative learning; higher education; inclusion; interdisciplinarity

## 1. Introduction

In September 2015, the United Nations general assembly (leaders from 193 countries of the world) adopted 17 sustainable development goals as an action plan to transform the world (people, planet, and prosperity) by the year 2030 [1]. The Sustainable Development Goals (SDGs) are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to quality education [1].

Research related to the 17 SDGs appears in various disciplines in the academic domain, and the studies are systematically interrelated to each other [2,3]. In this sense, it is also necessary to adopt

an interdisciplinary approach in education for sustainable development in the university context to enhance people's lives and advance sustainable development [4]. Although progress is increasingly being made in incorporating sustainable development into higher education studies, we need to rethink methodologies for developing sustainability skills in student education [5]. We need to develop skills such as interdisciplinary thinking, problem solving, teamwork, and holistic thinking [6,7].

Until recently, interdisciplinary thinking in higher education was very limited [8]. However, over the last two decades, a growing number of scientific papers have been published outlining university teaching projects and experiences based on an interdisciplinary approach [6,7]. This is because the problems facing the world today cannot be solved by any single discipline alone, but rather, as Ledford [9] argues, we must "bring people with different kinds of skills and expertise together. No one has everything that's needed" (p. 309).

The interdisciplinary approach has therefore become a key concept that should be integrated into all syllabuses at all educational stages. Adopting this approach involves linking different disciplines together and creating faculty and student teams, which enrich the general educational experience [10]. Despite the advances made in interdisciplinary research, innovation development and interdisciplinary teamwork, however, the implementation of this approach in higher education is still very slow [6,11], and further efforts are required.

In this sense, major institutions such as UNESCO [12], and many studies carried out in this field [11,13–15], have identified some of the interdisciplinary skills that higher education programs should seek to develop. Specifically, in a review of the literature on the development of interdisciplinary thinking in higher education, the authors of [8] forward the hypothesis that a positive relationship between certain conditions fosters the development of this outlook. According to the authors, these conditions are the student's personal conditions, including motivation and maturity; the conditions of the learning context, such as degree of interdisciplinarity and collaboration among the members of the teaching team; and the conditions of the learning process, i.e., learning activities and the development of interdisciplinary thinking.

Developing educational proposals, which seek to foster interdisciplinary learning, involves a change in the educational perspective and paradigm. As some authors [16] point out, the interdisciplinary perspective breaks away from educational models based on rote learning and involves a deep-rooted exploration of what is learned and how that knowledge is acquired. It means developing critical thinking and meta-cognitive skills, helping students to open their minds to different outlooks and to integrate the knowledge offered by other disciplines, in order to understand how concepts are related to each other and how learners construct knowledge in complex situations [17–19]. Some authors highlight the need for learning, teaching, and education to stay close to the problems of the real world when designing interdisciplinary learning activities in higher education [11,17–21].

Many studies have outlined the benefits of interdisciplinary learning, which include more advanced epistemological beliefs, greater capacity for critical thinking [6,19,22]; holistic thinking, combining diverse perspectives [13]; enhanced meta-cognitive skills [19]; and a better understanding of the relationships that exist between the perspectives stemming from different disciplines [16,19]. Some authors have also highlighted how participating in interdisciplinary teaching–learning groups encourages the adoption of a more interdisciplinary outlook, which goes beyond one's own discipline and acknowledges the contribution made by other disciplines to the resolution of the problem at hand [19]. As some authors [8], point out, it is important to design learning activities aimed at developing interdisciplinary skills, in order to encourage students to compare and analyze the conflicts that may exist between the approaches advocated by different disciplines, thereby stimulating the development of critical thinking and fostering a more holistic view of problems [16,23]. According to some authors [24], these activities should tackle real-world problems through experiences based on interdisciplinary collaboration, in which all members of the group participate actively, thereby maximizing interdisciplinary communication.

It is therefore vital for higher education to include more learning activities designed to foster interdisciplinary thinking and collaboration [25]. The aim is to stimulate interdisciplinary thinking in a gradual manner, moving towards learning based on real contexts and real problems, using appropriate methodologies.

Recent years have seen an increase in the number of studies linking interdisciplinary learning with the development of active methodologies such as problem-based learning and, more specifically, the case study method [26]. The case study method is based on presenting students with a problem in the form of a complex real-world situation and then challenging them to identify the strategies and tools required to resolve it and the roles to be played by each interested party [25]. Previous studies have found that teaching carried out in interdisciplinary teams has a positive effect on students' attitudes and ways of thinking [6], and some authors have highlighted the importance of moving away from more traditional activities in order to propose other forms of working, in which activities are carried out jointly by faculty from different disciplines, who talk with students about the topic in order to reinforce their knowledge and interdisciplinary outlook [19]. It is also important to adequately plan the different phases of the learning process to ensure the necessary scaffolding for interdisciplinary learning [11] and to guarantee that this type of teaching method becomes a successful interdisciplinary experience. Some studies that have implemented case methodologies or Project Based Learning (PBL) have developed criteria and different forms of evaluation such as student satisfaction surveys, evaluation of competences or skills and their triangulation [22], or others such as autoethnographies, a method in which interdisciplinary skills are analyzed from the reflection on the process of interdisciplinary work [27]. There are more and more experiences in which innovation methodologies are applied with an interdisciplinary perspective in very diverse higher education studies, such as engineering [28] and health [29].

Given the importance of developing interdisciplinary thinking in higher education, the objective of this research was to determine to what extent an interdisciplinary learning experience based on the case study method improves interdisciplinary thinking among university students and enhances participation, motivation, and cooperation from a collaborative and interdisciplinary perspective. The research project outlined below comprised three principle elements: (a) the interdisciplinary learning project was carried out in a learning environment based on a real problem with a strong interdisciplinary dimension, and with sufficient ingredients (challenge and need for information from other disciplines, yet at the same time similar to those experiences students will encounter in the future) to foster motivation among students and the need to adopt an interdisciplinary outlook in order to resolve the situation; (b) the design of interdisciplinary student teams with representatives from the Social Education, Primary Education, and Psychology undergraduate degree courses, with the aim of enhancing and fostering participation and motivation to collaborate among students from different disciplines and to reinforce the value of interdisciplinarity. The students were selected taking into account that students of different degrees (Social Education, Primary Education, and Psychology) were represented and taking into account that the subject that they were studying was related to socio-educational intervention. The teachers who conducted this research were professors of these different degrees that share an interdisciplinary view of education; (c) the experiences require a responsible teaching team with a strong interdisciplinary outlook. In this study, the teaching team comprised faculty from different disciplines of the three degree courses, all of whom shared the same concerns and interests and understood the need to promote the interdisciplinary approach in order to successfully respond to the special needs of young people during their educational career.

## 2. Materials and Methods

### 2.1. Sample

The sample comprised 539 university undergraduates from the Basque Country (Spain), 76.4% ( $n = 412$ ) female and 23.6% ( $n = 127$ ) male, of which 57.3% ( $n = 309$ ) were studying Primary Education,

23.9% ( $n = 129$ ) Social Education, and 18.7% ( $n = 101$ ) Psychology. Of the total, 41.6% ( $n = 224$ ) were in the first year of their degree, 34.5% ( $n = 186$ ) were in their second year, and 23.9% ( $n = 129$ ) were in their third year.

## 2.2. Instruments

### 2.2.1. Scale for Measuring Cooperative Learning

This questionnaire is organized on the basis of the five essential characteristics that cooperative learning must fulfill [30]: positive interdependence: the components of the group depend on each other to achieve the objective; promoting interaction: the members of a group must be in direct contact with each other to encourage and support each other; individual responsibility: each member of the group must be responsible for a part of the overall work; group processing: the group in common must reflect, speak, debate, and process the available information; and social skills: as a consequence of the previous elements, the group members will develop interpersonal communication skills (that is, to encourage, congratulate, actively listen, etc.), for management (that is, to respect, share, manage, mediate, etc.) or leadership (that is, to guide, explain, suggest, direct, etc.).

The questionnaire comprises 5 sub-scales, with 4 items per sub-scale (20 items in total): (1) interpersonal and small group skills (social skills, e.g., “listening to classmates’ ideas and points of view”); (2) group processing (e.g., “ideas are discussed amongst the group members”); (3) positive interdependence (e.g., “my classmates’ help is important to the completion of the tasks set”); (4) promotion of interactions (e.g., “the members of the group interact during tasks”); and (5) individual accountability (e.g., “every group member must participate in the tasks”). Each item/statement was rated on a 5-point Likert-type scale ranging from 1 (not at all true) to 5 (completely true).

Even though the questionnaire has only been validated for secondary school and baccalaureate students (up to age 18), it was nevertheless found to have a good/acceptable reliability index for the sample of university undergraduates participating in this study (Cronbach’s alpha for the overall questionnaire: 0.92; interpersonal and small-group skills: 0.73; group processing: 0.74; positive interdependence: 0.63; promotion of interactions: 0.73; and individual accountability: 0.72).

### 2.2.2. Class Participation Factors Questionnaire (CPFQ)

This questionnaire analyzes both dispositional and situational aspects of classroom participation understood as verbal report and/or analysis of materials written or audiovisual that promotes active learning that benefits critical thinking, listening skills, and talking, as well as attention and involvement in class [31]. It comprises 14 items and is divided into three dimensions, two of which correspond to dispositional factors and one to situational factors. Five of the 14 items focus on communication skills (“I talk fluently and with a good tone of voice when participating”), four measure disposition to study (“I read the materials we are given for discussion in class”), and five measure perceptions of faculty and classmates’ attitudes (“My classmates mock me when I participate or give a presentation”; “Faculty make me feel bad when I say something that is incorrect”). Items were rated on a 5-point Likert-type response scale (from 1 = strongly disagree to 5 = strongly agree). The Cronbach’s alpha for this scale was 0.81.

### 2.2.3. Personal Academic Motivation Scale

This scale is designed to assess personal academic motivation, understood as deliberate motivation to learn or deliberate motivated learning. The scale comprises 84 items, distributed across six dimensions [32]. For the purposes of this study, only three of the six dimensions of the scale were used: (a) attitudes to learning from the perspective of the student’s orientation (success, failure, overstrain, or resignation), with a total of 18 items (alpha = 0.67; “I get very involved in academic tasks”); (b) conditions under which the student studies and engages, aspects linked to their ability to plan, their dedication, individual and group work, effort, participation, resistance, or responsibility

and autonomy, with a total of 12 items ( $\alpha = 0.75$ ; “I consider myself a competent student”); (c) the student’s learning strategies, i.e., using prior knowledge, using adequate sources and diverse resources, ability to select relevant content and/or global reading, with a total of 10 items ( $\alpha = 0.83$ ; “I use my previous knowledge”). Items were rated on a 7-point Likert-type response scale.

#### 2.2.4. Interdisciplinary Learning Scale

A scale was created ad hoc to measure the interdisciplinary dimension. Students were asked to imagine they were assigned a case involving a child in second year of primary school, on which they had to work in conjunction with different professionals. The instrument comprised five items measured on a 5-point response scale: “Would you feel comfortable sharing the information you have with them?”, “Would you feel comfortable making your limitations or lack of knowledge known?”, “Do you think they would interfere with your way of working?”, “Would you accept other people’s suggestions for changing things?”, and “Do you think it is necessary to work in an interdisciplinary way (as part of a group), alongside other professionals?”. The Cronbach’s alpha for this scale was 0.65.

### 2.3. Design and Procedure

The study followed a pretest–posttest repeated measures design using a descriptive, comparative, and correlational methodology. The sampling was incidental, selecting those students who were taking subjects related to socio-educational intervention that were taught by the teachers who participated in this research. The research was carried out during the 2018–2019 academic year.

The process was divided into three phases: (1) the pretest phase, in which students’ cooperative learning, participation, motivation, and interdisciplinary perspective were analyzed; (2) the implementation phase, in which a case study was developed from an interdisciplinary point of view over the course of 15 weeks; and (3) the posttest phase, in which students’ cooperative learning, participation, motivation, and interdisciplinary perspective were explored once again, in order to analyze whether their perceptions of cooperation had changed during this period. Members of the research team administered the questionnaires to participants in the classroom during normal class time in a 15–20 min evaluation session.

During the implementation phase, the students were given a real case study and asked to analyze it and prepare an intervention designed from an interdisciplinary point of view. The case involved an 8-year-old boy with an intellectual disability. A teacher, psychologist, and social educator had to work together to provide a coordinated response to the child’s academic, family, and personal situation. Students were asked to assume the role of the corresponding professionals (the Primary Education students assumed the role of tutor, the Social Education students that of social educator from basic Social Services, and the Psychology students that of school counselor or psychologist) and to agree upon a coordinated plan of action with the aim of improving the child’s wellbeing. They were therefore required to work cooperatively, since the task was completed not only in single-discipline groups (comprising students from the same discipline), but also in interdisciplinary teams comprising students from different disciplines and different degree years.

The study complied with the ethical values established for research with humans (informed consent and right to information, data protection and confidentiality, non-payment, non-discrimination, and withdrawal from the study at any time).

### 2.4. Statistical Analysis

The data were analyzed using SPSS (version 21). To explore the impact of the methodology used on the variables studied, two types of analysis were conducted. Firstly, the scores obtained by participants before (pretest) and after (posttest) the implementation of the program were compared using the Student’s *t* statistic for related samples. Secondly, the effect size associated with each mean comparison was also calculated using *r* and Cohen’s *d* statistics.

### 3. Results

#### 3.1. Cooperative Learning: Differences before and after the Implementation of the Interdisciplinary Experience Based on the Case Study Method

Table 1 shows participants' mean scores and standard deviations in relation to cooperative learning, before and after engaging in the experience based on the interdisciplinary analysis of a case study. It also presents the Student's *t* and *r* values obtained in the pretest–posttest comparison.

**Table 1.** Students' mean scores and standard deviations in cooperative learning, assessed before and after the case study experience, Student's *t*, Cohen's *d*, and *r* values.

Scale for Measuring Cooperative Learning	Pretest Scores	Posttest Scores	Student's <i>t</i>	<i>df</i>	<i>d</i>	<i>r</i>
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
Cooperative Learning	4.05 (0.38)	4.27 (0.47)	−6.730 ***	158	0.51	0.25
Interp. and s. group skills.	4.11 (0.53)	4.27 (0.51)	−3.741 ***	158	0.32	0.15
Group processing	4.15 (0.48)	4.29 (0.52)	−3.508 **	158	0.28	0.13
Positive interdependence	4.26 (0.47)	4.22 (0.55)	0.872	158	−0.07	−0.03
Promotion of interactions	4.22 (0.54)	4.21 (0.55)	0.161	158	−0.01	−0.01
Individual accountability	4.53(0.55)	4.38(0.59)	2.982 **	158	−0.06	−0.13

Note: Interp. and s. group skills = Interpersonal and social group skills; \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

The results reveal that the interdisciplinary experience based on the case study method improved participants' scores in the cooperative learning dimension. Of the different aspects analyzed within this dimension, interpersonal and small group skills and group processing were found to be significant. Scores for individual accountability were lower in the posttest than in the pretest.

#### 3.2. Participation: Differences before and after the Implementation of the Interdisciplinary Experience Based on the Case Study Method

Table 2 shows participants' mean scores and standard deviations in relation to the participation factors, before and after engaging in the experience based on the interdisciplinary analysis of a case study. It also presents the Student's *t* and *r* values obtained in the pretest–posttest comparison.

**Table 2.** Students' mean scores and standard deviations in participation variables, assessed before and after the case study experience, Student's *t*, Cohen's *d*, and *r* values.

Class Participation Factors Questionnaire (CPFQ)	Pretest Scores	Posttest Scores	Student's <i>t</i>	<i>df</i>	<i>d</i>	<i>r</i>
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
Participation factors	3.12 (0.31)	3.20 (0.40)	−2.477 **	158	0.22	0.11
Communication	4.57 (0.77)	4.72 (0.79)	−0.03641 **	158	0.19	0.09
Context	2.75 (0.42)	2.81 (0.52)	0.03451	158	0.21	0.06
Study	2.91 (0.37)	2.96 (0.52)	0.04442	158	0.08	0.04

Note: \*\*  $p < 0.01$ .

The results reveal significant differences in participation factors between the pretest and posttest values, with the means being higher following the intervention. As regards the different aspects analyzed within this dimension, communication was found to be significant, with values again being higher following the intervention.

### 3.3. Motivation and Interdisciplinary Outlook: Differences before and after the Implementation of the Interdisciplinary Experience Based on the Case Study Method

Table 3 shows participants' mean scores and standard deviations in relation to motivation and interdisciplinary outlook, before and after engaging in the experience based on the interdisciplinary analysis of a case study. It also presents the Student's *t* and *r* values obtained in the pretest–posttest comparison.

**Table 3.** Students' mean scores and standard deviations in motivation and interdisciplinary outlook, assessed before and after the case study experience, Student's *t*, Cohen's *d*, and *r* values.

Personal Academic Motivation Scale and Interdisciplinary Outlook	Pretest Scores	Posttest Scores	Student's <i>t</i>	<i>df</i>	<i>d</i>	<i>r</i>
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
Motivation: attitude	3.96 (0.49)	4.14 (0.63)	−3.433 **	158	0.32	0.15
Motivation: learning conditions	5.06 (0.72)	5.08 (0.79)	−0.431	158	0.02	0.01
Motivation: learning strategies	5.05 (0.82)	5.16 (0.95)	−1.802	158	0.13	0.06
Interdisciplinary outlook	7.49 (0.96)	7.76 (0.89)	−3.290 **	158	0.29	0.14

Note \*\*  $p < 0.01$ .

As regards motivation, while attitude (success, failure, overstrain, or resignation) was found to be significant after the intervention, learning conditions and learning strategies were not.

However, the analyses did reveal significant differences in relation to interdisciplinary outlook, with the means being higher after the intervention.

## 4. Discussion

The development of a sustainable future is the responsibility of everyone, including, of course, higher education institutions. It is important to develop sustainable skills in students, and to achieve this goal interdisciplinarity is of great importance. The present study aimed to develop personal initiative in the university sphere by implementing an interdisciplinary case study methodology oriented towards fostering interdisciplinary learning and increasing cooperative learning, participation, and motivation among students. Based on the results obtained in the study, we can conclude that the use of the interdisciplinary case study method improved students' levels of interdisciplinary learning. Previous studies have reported how the use of interdisciplinary learning techniques [11,19,33] and learning based on the case study method [25] enhances students' interdisciplinary outlook. The case study method is believed to offer a wide range of opportunities for students to put themselves in the shoes of the professional practitioners dealing with the case in question. Working on a real case shows students that interdisciplinarity will necessarily be a part of their future job, in which they will have to coordinate with professionals from different disciplines. Regarding practical implications, interdisciplinary competencies already play an important role in academic formation but are especially relevant in professional life, and, therefore, are increasingly being demanded in this context; the case study as a methodology offers students the opportunity to acquire these skills alongside their academic education.

It is vital to train students in this interdisciplinary outlook, but in order for this training to be effective, students themselves must become aware of its necessity. The case study method offers the required opportunities for reflection, analysis, and meta-cognition. On a theoretical level, it seems that the case study as a methodological strategy made students more conscious of the need to adopt a professional perspective based on interdisciplinarity. In the present study, students scored higher for interdisciplinary outlook in the posttest phase, meaning that after the experience they said they would be more willing to share information, as well as their limitations or lack of knowledge, with other professionals, and were more open to accepting proposals for changing things made by practitioners

from other disciplines. In sum, the experience afforded them a deeper understanding of the need to work in an interdisciplinary manner in their future professional career.

As regards the impact of the intervention on the other variables measured, it should be noted that it improved both participation and cooperative learning. These findings are consistent with those reported by other studies that observed a relationship between interdisciplinary learning and increased student participation [19] and cooperative learning [34]. In specific terms, the present study found that interpersonal and small group skills and group processing scores increased in the posttest phase, although individual accountability scores were lower. One possible interpretation for this may be that the more individual perspective was overcome by the need to work as part of a team. It is worth highlighting that participants also perceived (it should not be forgotten that the data were collected through self-report questionnaires) their communication skills to have improved after the case study experience.

Furthermore, a change was observed in student motivation, specifically in participants' attitude to learning. Previous studies have also highlighted the impact of the interdisciplinary outlook and the case study method on student motivation [6,19,34]. In our study, we observed that following the case study experience, students were more success-oriented, valued effort more highly, and felt less anxious about failure, all of which are key attitude-related aspects of intrinsic motivation. Forming part of an interdisciplinary team not only involves a responsibility to contribute knowledge from one's own discipline but also means keeping an open mind about new ways of looking at things, only in this way can the team come to a shared interpretation of the case and propose interventions based on consensus. All this may have clear implications for the motivation felt by different members of the team, in the sense observed in this study.

## 5. Conclusions

We can therefore conclude that using the case study methodology from an interdisciplinary perspective is very useful for ensuring high-quality teaching, given that it helps foster aspects that are vital to the teaching–learning process of university undergraduates. Educational practitioners should continue to focus on and research these types of experiences, since this will enable them to acquire skills which will prove extremely beneficial to students in their educational career. At the same time, contributions may not be limited to teachers and students but also to the researchers analyzing relevant learning skills such as motivation and collaborative work, and to society as a whole in terms of sustainable developmental goals (SDGs) for quality education.

This study is not without its limitations. The first and most important limitation was the absence of a control group, which would have enabled us to evaluate the scores obtained in another, more direct, manner. Future research should be carried out with a control group that should take the same subjects in the same degree courses with the same teachers but following a different methodology, so that the efficacy of the methodology explained in this study could be analyzed with an experimental or quasi-experimental design. A second limitation is linked to the fact no assessment was carried out of the personal and professional characteristics of the faculty members guiding the intervention and how these may have influenced its effects. The third was the exclusive use of self-reports; future studies should also include reports from third parties in order to contrast student self-perceptions. It would also be interesting to collect information in a qualitative way, in order to complete the information collected in the self-reports.

Nevertheless, we believe this is an interesting avenue of research that may prove fruitful in the future. In fact, we consider that the incorporation of methodologies such as the educational innovation project presented here and its results can help in the process of transformation of pedagogies in university studies and encourage the development of skills among students such as critical thinking, cooperation, and teamwork from a more holistic interdisciplinary perspective, which is important for the development of sustainable education. Moreover, the study presented here may serve as a basis for

the encouragement of changes in educational programs, especially at universities and in relation to one of their main roles, to ensure high-quality sustainability education.

**Author Contributions:** Conceptualization, I.A. and J.J.; methodology, N.B. and A.A.; formal analysis, N.B. and A.A.; investigation, A.A.-I. and N.G.; data curation, A.A.-I. and N.G.; writing—original draft preparation, N.B., I.A. and J.J.; writing—review and editing, A.A., A.A.-I. and N.G.; supervision, N.B. and I.A.; funding acquisition, J.J. All authors have read and agreed to the published version of the manuscript.

**Funding:** The Research Project was sponsored by the University of the Basque Country (Spain), with grant number EHU-HBT19-20, Cod. 133.

**Conflicts of Interest:** The authors declare no conflict of interest.

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