sustainability

MDPI

Article

Cross-Disciplinary Analysis of Cooperative Learning Dimensions Based on Higher Education Students' Perceptions

Dolors Cañabate [1,2,*,†], Maria Luisa Garcia-Romeu [2,3,†], Anna Menció [2,4,†], Lluís Nogué [1,2,†], Marta Planas [2,5,†] and Joan Solé-Pla [2,6,†]

1 Grup de Recerca en Educació, Patrimoni i Arts Intermèdia (GREPAI), Department of Specific Didactics, Faculty of Education and Psychology, University of Girona, 17004 Girona, Spain; lluis.nogue@udg.edu
2 Teaching Innovation Network on Cooperative Learning, Institute of Sciences Education, University of Girona, 17003 Girona, Spain; mluisa.gromeu@udg.edu (M.L.G.-R.); anna.mencio@udg.edu (A.M.); marta.planas@udg.edu (M.P.); joan.sole@udg.edu (J.S.-P.)
3 Grup de Recerca en Enginyeria de Procés, Producte i Producció (GREP), Department of Mechanical Engineering and Industrial Construction, Polytechnic School, University of Girona, 17003 Girona, Spain
4 Grup de Geologia i Cartografia Ambiental (GAiA), Department of Environmental Sciences, Faculty of Sciences, University of Girona, 17003 Girona, Spain
5 Laboratori d'Innovació en Processos i Productes de Síntesi Orgànica (LIPPSO), Department of Chemistry, Faculty of Sciences, University of Girona, 17003 Girona, Spain
6 Xarxes Organitzatives, Innovació i Desenvolupament d'Estratègies i Productes Turístics (ONIT), Department of Economy, Faculty of Economic and Business Sciences, University of Girona, 17003 Girona, Spain
* Correspondence: dolors.canyabate@udg.edu
† Authors appear in alphabetical order.

Received: 29 August 2020; Accepted: 29 September 2020; Published: 2 October 2020

Abstract: This study analyzes the perception, mainly on motivation, interpersonal relationships, and learning outcomes, of higher education students from seven university disciplines derived from Cooperative Learning (CL) activities undertaken in the course of their degree studies. The cross-disciplinary dimensional analysis on cooperative learning included students' motivation, academic performance, students' relationships within cooperative groups, group organization, and teacher involvement. The study was carried out using a questionnaire validated by a number of CL experts. The subsequent analysis of a sample of 162 student's perceptions on the CL dimensions provided first, positive students' perceptions regarding satisfaction, motivation, learning outcomes, and interpersonal relationships, and second, that differences between university degrees on CL were significant, suggesting a strong dependence of cooperative dimensions on the implemented approach.

Keywords: cooperative learning; higher education; teacher involvement

1. Introduction

Cooperation is seen as an educational methodology that is based on providing students with the skills for sustainable development, and relies mainly on integrating group strategies into personal development. Education for sustainable development, when developed in tertiary systems, enhances students' ability to understand and interact with the environment and with society in order to best identify individual and collective impacts [1]. Therefore, university teachers should be aware of transferring sustainability skills and contents to enhance sustainable competences to the teaching profession. It entails promoting student relationships within groups and fostering relationships in socialization and learning with the environment and with the society [2–4]. Cooperative learning is

directed towards promoting group development during strategic action, interpersonal relationships, as well as collaboration, personal involvement, and individual responsibility [5,6]. It empowers students to change their way of thinking and to work towards a sustainable future by confronting dilemmas with other students while activating cooperation [1,6]. How students cooperate and how they are progressing in this process implies a continuous process of reconsidering what they learn in practice [7], which is a fundamental element of sustainable education. When selecting staff, social skills such as the ability to cooperate, communicate, or work in a team are highly valued by human resources departments in companies and public or private institutions. However, despite an improvement in the situation in recent years, these skills are not yet sufficiently addressed in the curricula of most university degrees. Cooperative Learning (CL) is an educational approach in which students work in small heterogeneous groups in order to help each other learn. Giving and receiving help under the active guidance of the lecturer is considered one of the best strategies for learning [8–10]. It creates mutual help relationships [11] between individuals and groups and is aimed at achieving a goal through combined effort and mutual reward [12–18].

According to Johnson and Johnson [19,20] in order for cooperation to exist within a small group, several essential elements must be present. These components distinguish cooperative learning from teamwork, and are as follows: (a) Positive interdependence. The group members' learning depends on the actions that each member of the group performs; (b) face-to-face interaction. At some point in the process, the members of the group work face-to-face, bettering their social adaptation and competence; (c) individual responsibility. No member of the group can be successful without the success of the others; (d) small group interpersonal skills. Learners must learn interpersonal and communication skills along with other skills in order to accomplish common goals; (e) group processing. A cooperative group works well when it reflects on its performance.

Pujolas [21] states that a cooperative learning structure is made up of a number of components such as tools, techniques, strategies, or support mechanisms. In general, students clearly perceive that cooperative work is beneficial to them insofar as it enables them to improve their expectations of achieving better academic results in addition to improving their social skills and teamwork competencies [22–25]. Furthermore, if students are consciously engaged in cooperative learning [26], this often leads to pleasant learning situations which favor equal opportunities, as friendly relationships replace any rivalry. As students have greater control over their own learning process, this leads to increased motivation [27–32]. However, not all students feel satisfied within a cooperative learning context, particularly in a higher education setting. Many express the need for active and constant feedback from both teaching staff and fellow students so that the autonomous, shared, and critical learning process can take place [14]. In this vein, Tran [33] and Laguador [27] point out that when students perceive improved learning within a cooperative context, their attitude towards learning also improves. The extent of students' satisfaction with the education they receive also ultimately benefits the institution, as it is seen as providing quality education.

Despite the advantages of CL mentioned above, teaching and learning in cooperative contexts also presents risks. Social and interpersonal skills such as attentive listening, leadership skills, respectful negotiation, cooperative questioning, decision making, confidence building, and conflict management need to be taught to enable learners to cooperate effectively in a group environment. If these skills are not taught, it is very likely that CL activities will be unsuccessful [34–36]. To coordinate efforts in accomplishing reciprocal goals, participants should (a) know and trust each other; (b) communicate accurately and unambiguously; (c) accept and support each other; and (d) resolve conflicts constructively [18,37,38].

Cooperative Learning is not a newcomer to the world of education. As Tombak and Altun [39] point out, it originated before Johnson, Johnson, and Smith's seminal article published in 1998. However, it is only in recent decades that cooperative learning has been successfully implemented as a methodology and practical teaching method in contrast to traditional teaching methods [3,40,41]. In this regard, numerous studies have been carried out on cooperative learning which demonstrate its effectiveness in

academic achievement in various fields and a number of educational levels [42–44]. CL also promotes students' affective, cognitive, and social development [3,14,36,45–48] and is considered a methodological tool capable of responding to the individual needs of 21st century students [10,11,18,46,49]. CL creates positive interpersonal relationships which give personal and academic support, improves mental health and well-being (including self-esteem and social skills), and promotes a positive attitude towards the university experience, as it involves student interaction and fosters relationships in socialization and learning [3,4,50].

In summary, various authors state that CL leads to the following: (1) Positive correlation achievements; (2) accomplishing shared goals; (3) developing processes of interaction; (4) understanding cooperation as a key to learning; and (5) responding to diversity [51–54].

CL is employed in various disciplines within the higher education system, although the majority of research on CL is carried out within faculties of education [50,55–57]. In all fields, CL is present in the learning objectives and content of the degree studies. Some studies compare the effectiveness of CL with traditional university learning methods in different university programs; however, few transdisciplinary studies exist on this topic. Therefore, this study aims to contribute to the existing literature by providing empirical evidence on the effects of cooperative learning through a cross-sectional analysis of various university degree studies.

This study is mainly addressed to respond to how students from various university disciplines perceive Cooperative Learning Activities (CLA). Towards this purpose, first, the relationship between the grades obtained in CL activities and the final grade awarded for the subject was analyzed, then a survey was designed to determine the satisfaction students felt with the activities. The survey took into account student motivation, learning assessment, group relationships, CLA organization, and the involvement of the teaching staff. Therefore, the objective of this study is to gain information on the perceptions that university students from different degrees have after implementing in-class cooperative educational approaches, with special interest on students' perceptions on teacher involvement as well as on students' motivation, organization, and internal member relationships.

2. Materials and Methods

2.1. Context of the Study

This study was conducted within the framework of the Network of Educational Innovation in Cooperative Learning (XIDAC), at the University of Girona (UdG), during the academic year 2018–19. XIDAC members lecture on a variety of degrees which include Environmental Sciences, Chemistry, Mechanical Engineering, Business Administration and Management, and Primary School Education. Table 1 shows the university subjects encompassed in this study and describes the structure and main characteristics of the Cooperative Learning Activities (CLAs) covered in this project. All teaching staff involved in XIDAC ensured that all activities undertaken through Cooperative Learning complied with Johnson and Johnson´s five criteria [20,58]: (a) Positive interdependence, (b) face-to-face interaction, (c) individual responsibility, (d) small group interpersonal skills, and (e) group processing.

Table 1. Type of Cooperative Learning Activities (CLA) by subject. Legend: Group creation, how the groups are created; group duration; % CLA grade, percentage of CLA grade in relation to the overall grade for the subject.

Subject	Degree	Year	Type of CLA	Group Creation	Group Duration	% CLA Grade
Hydrogeology (HG)	Environmental Sciences	2nd	In HG, the CLA proposed is a complete hydrogeological project carried out in groups of 2–3 students over two weeks.	By students	Stable	45%
Design of Organic Molecules (DOM)	Chemistry	4th	In DOM, students work in groups of 3–4 and are asked to search for the synthesis of a commercial drug, then present it to the other students in a poster session.	By students	Stable	10%
Manufacturing Processes (MP)	Mechanical Engineering	3rd	In MP, groups of 3 students are asked to analyze the manufacturing process of a consumer good, present their work in a poster session, and then defend it in an oral presentation.	By lecturer	Punctual	12.5%
World and Spanish Economy (WSE)	Business Administration and Management	2nd	In WSE, students are required to study a pertinent question on the world and Spanish economy, then write a report and prepare a presentation, followed by a class discussion.	By students	Punctual	20%
Physical Education (PE)	Primary School Education	2nd	In PE, groups of 4 prepare activities related to specific blocks of this subject to be developed in schools.	By students	Stable	20%
Physical Education Didactics (PED)	Primary School Education	4th	In PED, over 8 sessions, groups of 4 write a didactic unit of CLAs, which are to be developed in schools in 8 sessions.	By students	Stable	30%
Physical Education Didactic Resources (PEDR)	Primary School Education	4th	In PEDR, groups of 4 use CLA methods to create three cooperative challenges to be developed in primary schools.	By students	Stable	20%

2.2. Participants

The total number of students involved was 299, and the percentage of response of the survey proposed was 54.18%. Therefore, the total number of answers to the survey was 162. Table 2 shows the number of students of each subject in the study, the number of answers given, and the percentage of each Cooperative Learning Activity (CLA) per subject.

Table 2. Description of the students' participation in this study and importance of each CLA in the grading of each subject. Legend: CLA code, Cooperative Learning Activity code; Num. Students, number of students enrolled in each subject; and Num. Answers, number of answers obtained in each survey.

CLA Code	Subject	Num. Students	Num. Answers
HG	Hydrogeology	66	17 (25.8%)
DOM	Design of Organic Molecules	18	12 (66.7%)
MP	Manufacturing Processes	40	26 (65.0%)
WSE	World and Spanish Economy	59	53 (89.8%)
PE	Physical Education	52	26 (50.0%)
PED	Physical Education Didactics	30	8 (26.7%)
PEDR	Physical Education Didactic Resources	34	20 (58.8%)

2.3. Survey Design

To construct the survey, first, an extensive bibliographic search on cooperative learning was carried out that served to define the elements, indicators, parts, and questions of the survey. Second, the survey was submitted to a validation process that used the judgments of external experts, who confirmed the usefulness of this instrument. Third, we carried out a pilot test with a group of students from different university degrees to evaluate if they could easily understand the questions of the survey. From this process, we concluded that the survey met the requirements needed to achieve the aims of our research.

Students involved in this study were asked to answer online the designed survey (Google Forms). The survey was available for 1 week after completion of the subject. All answers are individual and anonymous.

The survey consisted of 20 statements divided in 5 dimensional blocks and evaluated the following: (1) Level of motivation; (2) learning outcomes and time spent on the CLA; (3) relationship with the rest of the members of the group; (4) organization of the CLA; and (5) involvement of the teaching staff (Table 3).

Table 3. Survey statements by thematic blocks.

Dimension Block	Code	Statements
Figure	B11	The CLA increased my motivation for the subject
	B12	The CLA made me more participative
	B13	I like these types of activities because I have to collaborate with fellow students
B2—Learning assessment and time spent	B21	This type of activity makes me feel more involved in my individual work
	B22	This activity helps me learn how to learn
	B23	I feel more responsible for my individual learning
	B24	This activity makes me feel more responsible for my fellow student's learning
	B25	This type of activity improves learning in the whole group
	B26	This activity has helped me understand this subject better
	B27	I have learned more in the time spent on this activity than working by myself
B3—Team relationship	B31	I feel that my fellow students listened to my opinions during this activity
	B32	I listened to my fellow students' opinions during this activity
	B33	This activity stimulated my critical thinking and I generated more ideas
B4—CLA organization	B41	Our team organization was productive/satisfactory
	B42	I liked the CLA dynamics
	B43	The classroom and the furniture (including how it was distributed) were appropriate for this activity
	B44	The supporting material supplied by the teaching staff was appropriate for this type of activity
B5—Involvement of teaching staff	B51	I felt the teaching staff were more motivated than in other subjects
	B52	My relationship with the teaching staff improved with this activity
	B53	The teaching staff organized this activity well

All responses were ranked in 6 categories: (0) No response/do not know (NR/DK); (1) strongly disagree; (2) somewhat disagree; (3) neither agree nor disagree; (4) somewhat agree; and (5) strongly agree (Table 3). In order to statistically analyze the results, the variation in satisfaction between categories was considered constant and "NR/DK" responses were not taken into account for the statistical treatment of the results. In addition, mean values for each block were also considered a metric of satisfaction for each block of statements.

2.4. Statistical Analysis

A two-fold analysis was carried out (Figure 1). Firstly, the initial analysis focused on the relationship between CLA grades and the final grade for the subject based on differences between CLAs grades and subject grades. This was conducted using the Kruskal–Wallis test, as most of the parameters analyzed were not distributed normally.

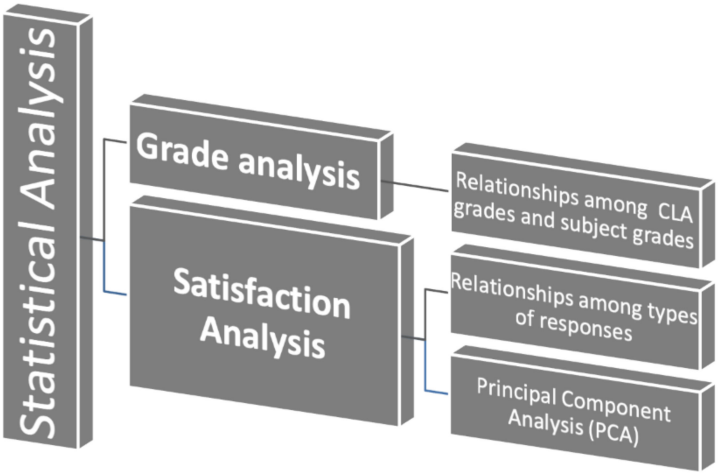

Figure 1. Statistical analysis process.

Secondly, student satisfaction was determined by analyzing the responses to the survey described in Table 3 above. SPSS software (version 23, 2015, SPSS Inc. Chicago, IL, USA) was used to estimate Pearson's correlation coefficients of the mean values of each block of responses (with a bilateral significance of 0.01), and in order to analyze possible relationships between types of responses and blocks of statements. Differences between degree studies were analyzed using the Kruskal–Wallis test for non-parametric data, as none of the responses were normally distributed.

In addition, a Principal Component Analysis (PCA) was conducted to analyze the association between the statements and type of response. This multivariate analysis approach is used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (Principal Components (PCs) [59,60]). Its goal is to reduce the information contained in a large number of original variables into a smaller set of PC variables with a minimum loss of information. In this study, we used PCA to group statements with similar responses, and to analyze students' perceptions of the various aspects of CLAs. After applying PCA, a varimax rotation was conducted. This enabled a "clean up" of the PCs by increasing the participation of variables with a higher contribution, while simultaneously reducing that of variables with a lower contribution. In this procedure, the number of original variables contributing to each PC (called henceforth varifactors (VF)) is reduced at the cost of a loss of orthogonality [59,60]. The dataset used for the PCA included all the responses obtained from the surveys ranked from 1 to 5, thus excluding responses "NR/DK".

3. Results

3.1. Relationship between Grades Obtained in CLAs and Final Grades for Subjects

The CLAs analyzed in the study were carried out in various degree subjects. The main characteristics of the activities are described in Tables 1 and 2, and the relationship between the grades obtained for CLAs and the final grade for the subject for each student are shown in Figure 2. These parameters are important, as they may condition how CLAs are evaluated in the survey.

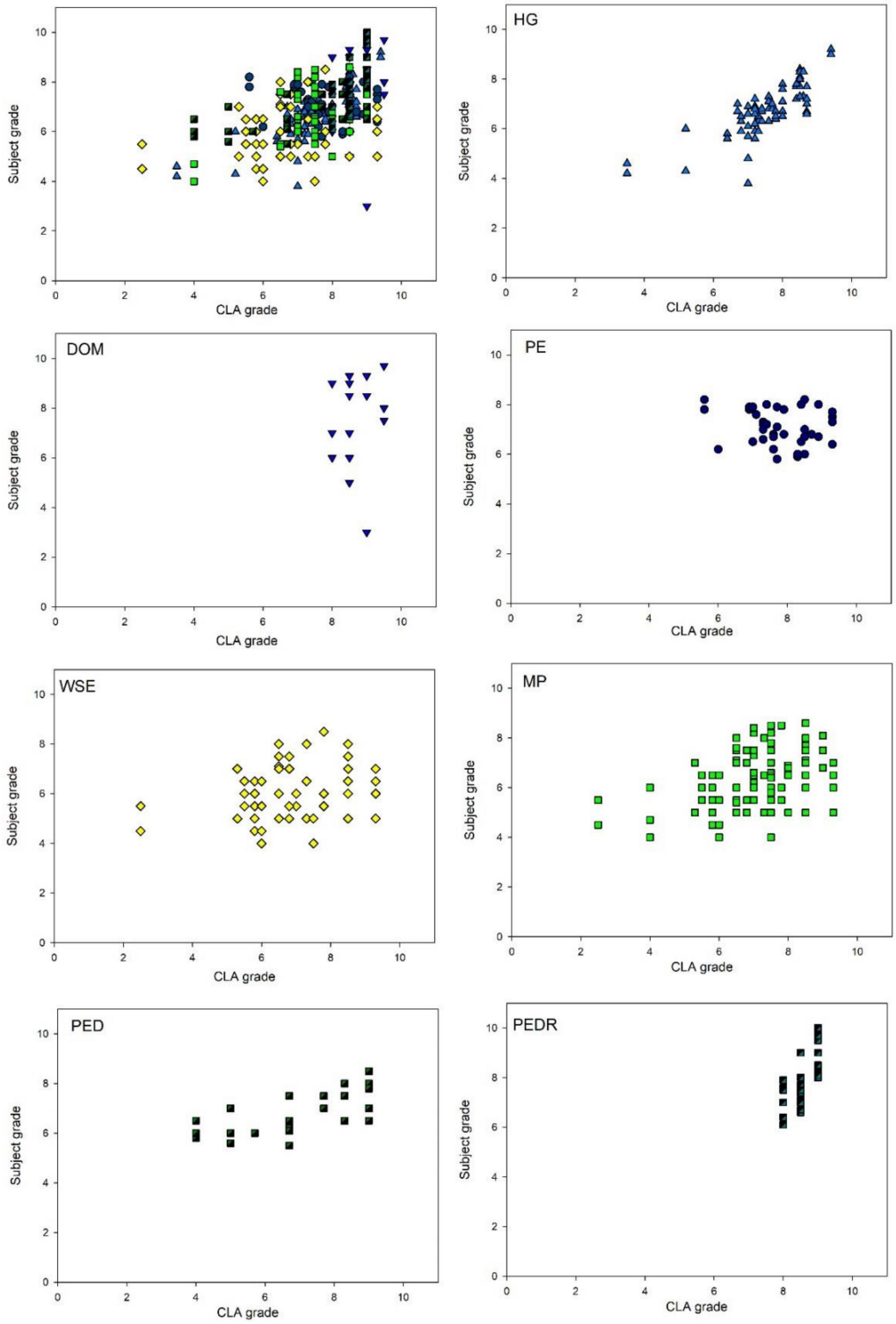

Figure 2. CLA grade vs. subject grade (0–10) for each student enrolled in each subject. In the top left plot, all the samples were considered. Legend: HG, Hydrogeology; DOM, Design of Organic Molecules; MP, Manufacturing Processes; WSE, World and Spanish Economy; PE, Physical Education; PED, Physical Education Didactics; PEDR, Physical Education Didactic Resources.

Figure 2 shows that in the majority of subjects, the highest CLA grades relate to the highest final grades in the subject, showing a significant correlation between these two parameters (R = 0.584). However, there were some differences between subjects and the way in which the CLA grades were

evaluated. For example, in Design of Organic Molecules (DOM) and Physical Education Didactic Resources (PEDR), all students obtained a CLA grade ≥ 8. In the case of Hydrogeology (HG), World and Spanish Economy (WSE), Manufacturing Processes (MP) and Physical Education Didactics (PED), grades varied from 2 to 9.5; and finally, in Physical Education (PE), the CLA grades ranged from 5.6 to 9.3. Regarding the final grades of the subject, in DOM, values varied from 2 to 9; in HG, WSE, MP, and PED, students obtained final grades ranging from 4 to 9. The highest grades were observed in PEDR that varied from 6 to 10.

Consequently, when the CLA grades for the various subjects were compared using the Kruskal–Wallis test, PEDR, and DOM, CLA grades could be considered similar (p-value = 1.000); however, significant differences were detected between these two subjects and the rest of the subjects (p-values < 0.001–0.049). Significant differences were also detected between WSE and PE CLA grades (p-value = 0.042).

When the final grades of the subjects were analyzed, differences between WSE and the rest of the subjects were detected (p-values ranging < 0.001 and 0.010), as were differences between PEDR and subjects such as HG, PE, and PED (with p-values between < 0.001 and 0.002). In this case, students obtained the lowest grades in WSE (6.00 ± 1.06), and the highest grades in PEDR (7.94 ± 0.99).

Finally, it was observed that for 76.7% of the students, the cooperative learning activities contributed to obtaining a better final grade, with no significant differences detected between subjects (p-value = 0.273).

3.2. Analysis of Student Satisfaction with the CLAs

Students' satisfaction with CLAs was analyzed using the survey described in Table 3. The results are summarized in Figure 3. For motivation statements (B1), 52.2% of the students felt that CLAs had increased their motivation for the subject; 71.4% thought that CLAs made them more participative, and 61.7% liked this type of activity because it made them collaborate more with fellow students. Differences between the subjects were observed. In particular, the highest percentages for B1 statements were obtained for HG, DOM, PE, PED, and PEDR that ranged from 60 to 95%. In contrast, MP and WSE showed the lowest values (30 to 60%).

Regarding learning assessment and time spent (B2 statements; Figure 3), 55.1% of the students thought that CLAs encouraged them to be more involved in their individual work; 56.9% felt that these activities helped them learn how to learn; 57.4% felt more responsible for their individual learning; 56.8% thought that this kind of activity made them feel more responsible for fellow student's learning; 61.8% agreed that CLAs improved group learning; 57.2% of the students thought they had understood the subject better as a result of CLAs; and finally, 53.6% thought they had learned more in the time spent on this activity than working by themselves. When comparing the different subjects, in general, B2 statements followed a similar trend than B1 ones. Except for B21 and B24, for which MP and WSE showed similar percentages than DOM and HG (30 to 50%), for the other B2 statements, MP and WSE were the subjects with the lowest values, 30 to 55%. In contrast, the other subjects showed percentages ranging from 60 to 100%.

When the students were asked about their relationship with the other members of the group (Figure 3, B31, B32, and B33), 84.2% of them felt that their fellow students listened to their opinions during the activity, and 89.3% felt they listened to their fellow students' opinions during the CLAs. In addition, 69.4% agreed that CLA stimulated critical thinking. In these cases, MP and WSE also showed lower percentages (40 to 60%) than the other subjects (75 to 100%).

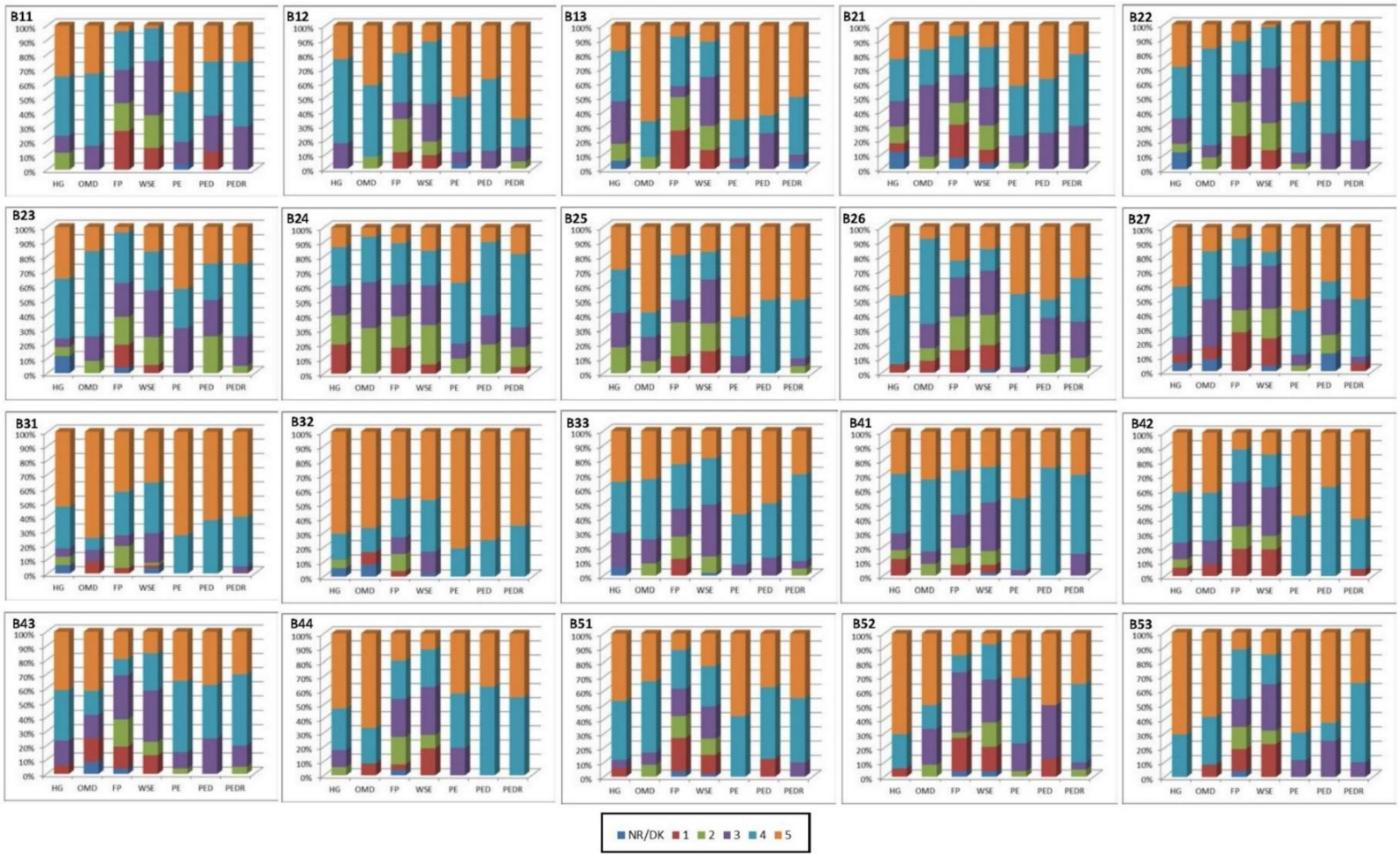

Figure 3. Results obtained from the survey. Legend: Each plot code corresponds to the statements in Table 2; HG, Hydrogeology; DOM, Design of Organic Molecules; MP, Manufacturing Processes; WSE, World and Spanish Economy; PE, Physical Education; PED, Physical Education Didactics; PEDR, Physical Education Didactic Resources; NR/DK, no response/do not know; 1, strongly disagree; 2, somewhat disagree; 3, neither agree nor disagree; 4, somewhat agree; and 5, strongly agree.

Regarding the organization of CLAs (B4 statements, Figure 3, B41, B42, B43, and B44), 70.2% of students thought that their group organization was productive and satisfactory; 64.2% liked CLA dynamics; 58.8% thought that the classroom, furniture, and distribution of the furniture were suitable for carrying out the activity; and 65.9% agreed that the supporting material supplied by the teaching staff was appropriate for carrying out this type of activity. MP and WSE were also the subjects with the lowest percentages for these B4 statements (35 to 60% vs. 65 to 100%).

Finally, when the students were questioned about their relationship with the teaching staff (teaching staff's involvement in B5), 70.7% felt the lecturer/professor was more motivated than in other subjects; 56.6% thought that their relationship with the lecturer/professor had improved as a result of CLA; and 65.9% thought that the teaching staff had organized the activity well. Similar to the other statements, the lowest percentages were obtained for MP and WSE, which ranged from 30 to 55%. The other subjects showed percentages that varied from 70 to 100%.

To analyze possible differences between subjects/degrees, a non-parametric test (Kruskal–Wallis test) was carried out, as none of the responses to the statements were normally distributed. The results showed (Figure 3):

1. In Block 1—Motivation, the main differences were detected between MP and WSE and the remaining subjects (with p-values between 0.44 to <0.001 in most of them), showing lower valuations for this block of statements in these two first subjects.
2. In Block 2—Learning assessment, differences in responses were mainly detected due to the lower values obtained in WSE and MP than some of the other subjects (e.g., PE, HG, and PEDR), or the higher valuations obtained of PE than other subjects (e.g., HG, MP, and WSE).
3. In Block 3—Group relationship, the differences between subjects were minimal and only detected between PE and WSE in statements B31 and B33 (p-value of 0.022 and 0.001), and between PED and MP in B33 (p-value of 0.006). Responses from PE and PED showed the highest values.
4. In Block 4—Organization and Block 5—Professor involvement, differences were mainly detected between WSE and MP, and the remaining subjects. However, these differences were not constant for all the statements. For example, in statement B41, the differences were only observed between WSE and PE (with a p-value of 0.009); in B44, differences were detected between WSE and HG, PE, PED, and PEDR, and between MP and PEDR (with p-values ranging < 0.001–0.042); and in B51, MP showed lower valuations than HG, PE, and PEDR (p-values of < 0.001–0.015), and WSE, than PE (p-value of 0.001).

A Principal Component Analysis was used here as a way to synthetize student's responses to the satisfaction survey, and to determine the various trends and relationships between statements and answers. The final solution included 3 components that explained 69.18% of the total variance. The value of the Bartlett chi-square statistic, by applying the sphericity test, was 2215.9 (for 190 degrees of freedom and a minimum significance level of <0.001), confirming that the survey variables were correlated. The measure of sampling adequacy (MSA) obtained by the Kaiser–Meyer–Olkin (KMO) measure was 0.918.

The three final varifactors (VF) obtained after a Varimax rotation were interpreted as follows (Table 4, Figure 4):

1. VF1, with 29.97% variance, was mainly composed of statements related to B5 (teaching staff's involvement), B4 (CLA organization), and B1 (student motivation), as well as statements B2, B25 (related to the improvement in group learning), and B22 (related to the process of learning to learn). In this regard, Figure 4d shows that the students who gave B1 the highest valuations were also those with the highest scores for VF1.
2. VF2 (22.50% of the variance) mainly comprises B2 statements (related to assessment of learning outcomes and time spent); B11 and B12 are related to motivation and involvement in the activity. Therefore, the students who gave the highest scores for VF2 were mainly those who gave the highest scores for Block 2 (Figure 4e).

3. VF3 represents 16.71% of the total variance. This comprised B3 statements (relationship block), and one of the Block 4 statements (B41) related to group organization. As with previous VFs, a high correlation is observed between VF3 and B3 mean values (R^2 = 0.867; Figure 4f).

Table 4. Loadings of the 20 statements analyzed on the 3 significant varifactors (VF). Statements are detailed in Table 3. Underlined values represent relevant loadings.

Statement	Varifactors		
	VF1	**VF2**	**VF3**
B53_CLA Organization	0.813	0.297	0.228
B51_Prof Motivation	0.803	0.290	0.156
B52_Prof Relationship	0.783	0.357	0.065
B44_CLA Material	0.715	0.237	0.242
B43_CLA Classroom	0.699	0.302	0.216
B42_CLA Dynamics	0.688	0.211	0.498
B11_Stud Motivation	0.661	0.519	0.165
B13_Stud Collaboration	0.651	0.363	0.383
B25_Group Learning	0.634	0.475	0.362
B23_Individual Learning Responsibility	0.255	0.823	0.024
B21_Individual Learning Involvement	0.154	0.801	0.132
B26_Subject content	0.391	0.691	0.260
B22_How to learn	0.528	0.668	0.155
B24_Fellow students' learning	0.310	0.607	0.293
B27_Time spent	0.478	0.599	0.301
B12_Participation	0.478	0.566	0.219
B32_Listening to fellow students	0.097	0.168	0.880
B31_Listened to by fellow students	0.206	0.138	0.826
B33_Critical thinking	0.170	0.202	0.678
B41_Team organization	0.430	0.068	0.595
Eigenvalue	5.99	4.50	3.34
% Variance explained	29.97	22.50	16.71
% Cumulative variance	29.97	52.47	69.18

According to the results of the study, most students who felt motivated by CLAs (the highest score for B1 statements), also thought that these activities were well organized (the highest scores for B4 answers) and that the lecturer/professor was heavily involved in the activity (the highest scores for B5; Figure 4). This perception was independent of the time spent on these activities, how the concepts related to the subject were learned (represented by VF2), or the relationship with the group and its dynamics (represented by VF3, and statement B41). Figure 4a–c show that there is no clear relationship between VFs.

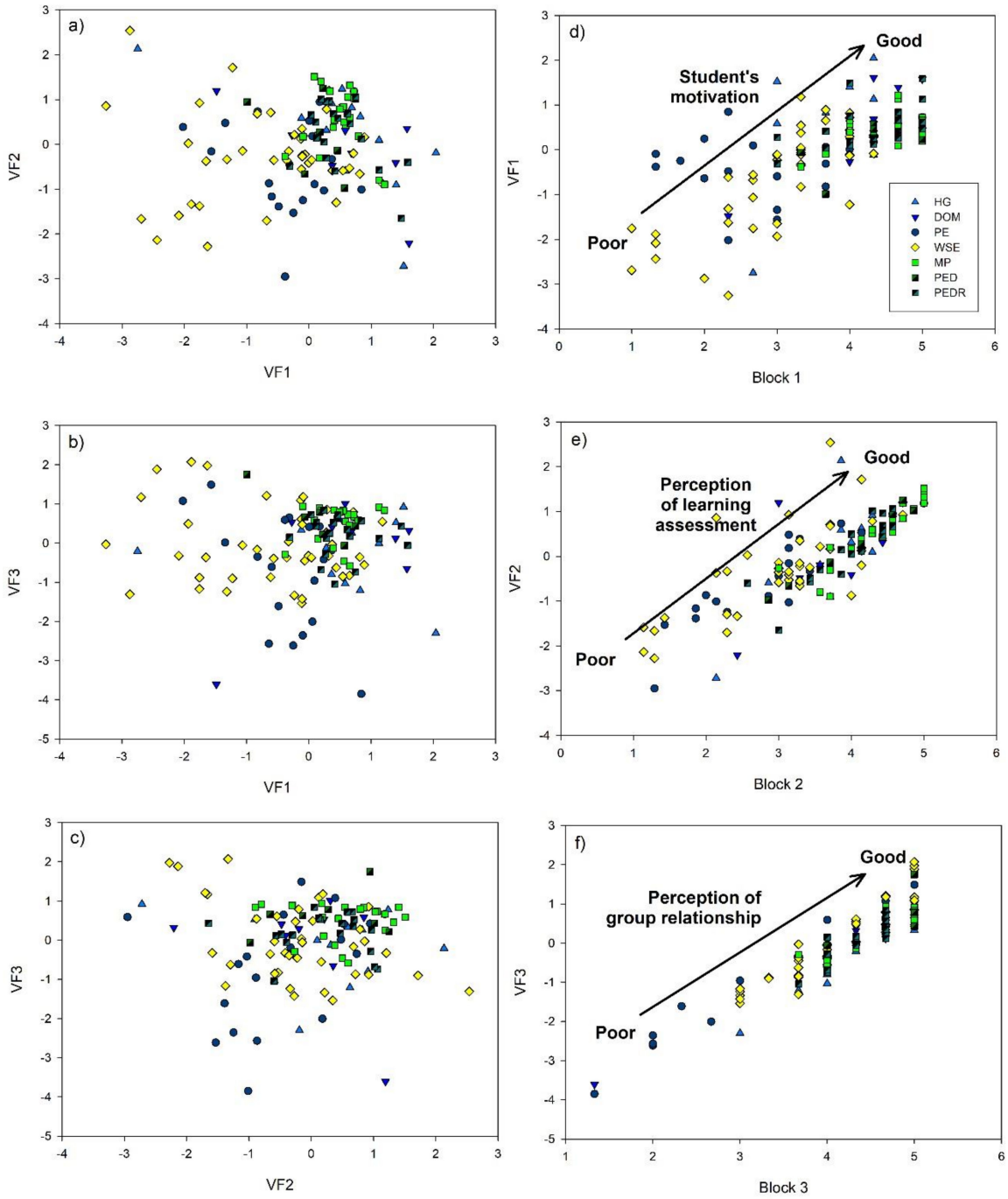

Figure 4. Relationships between varifactors, scores obtained for each VF, and the mean values of responses for each block: (**a**) VF1 vs. VF2; (**b**) VF1 vs. VF3; (**c**) VF2 vs. VF3; (**d**) VF1 vs. Block 1 mean values; (**e**) VF2 vs. Block 2 mean values; and (**f**) VF3 vs. Block 3 mean values.

4. Discussion

This research analyzed university students' perceptions of cooperative learning activities carried out within the framework of subjects taught in various university degrees. The study looked at whether the CL activities helped improve students' final grades in each subject. In general, it was observed that all CL activities contributed to students obtaining a better overall grade for the subject. From these results, it can be concluded that these activities have improved students' learning experience and the fact that they obtain better grades may also result in their positive assessment of these types of

activities. In this regard, the results coincide with the works which state that CLA favors accomplishing academic goals [13,21,42–46,61].

After analyzing the responses to blocks of statements on perspectives, results show that responses from students in the MP and WSE on the Mechanical Engineering and Business Administration and Management degrees (respectively), were generally the opposite to responses of students who study subjects PE, PED, and PEDR in the Primary School Education degree. In contrast, the remaining two subjects, DOM and HG on the Chemistry and Environmental Sciences degrees (respectively) occupy a more intermediate position. From a general point of view, a probable explanation could be related to possible entry barriers for students of these degrees, who may not be used to these types of learning activities. Traditionally, teaching staff in these degrees use CLA less than in those in education degrees, where this type of training is introduced in both theory (the students will be future teachers), and practice (in the classroom, students carry out collaborative learning activities). Moreover, the education degree at the University of Girona traditionally employs these types of collaborative activities. They are gradually introduced in the second year in PE, increasing to a number of CL activities in several final year subjects, e.g., PED and PEDR, a fact that may explain why the results obtained are higher than those of the initial year subjects [50,55–58].

The above analysis shows that the final and overall assessment of CLA is always positive in all subjects and degrees. This should encourage teaching staff in any degree subject to consider carrying out this type of activity. Student satisfaction with CLA is related to increased motivation resulting from the course contents, academic performance in relation to the effort put in, relationships with members of the working group, how the activity is organized, and the extent of the lecturer/professor's motivation. The questionnaire was thus designed to address these aspects.

By analyzing the interrelationship between CLA components, results show that the variables in which CLA increased student motivation (B11) and how this activity improved group learning (B25) positively correlate with all aspects related to how the activity was organized: Organization of the activity itself, material, space, and distribution of students. Furthermore, these variables also correlate with the teaching staff's motivation as perceived by the student, the dynamics of the activity, and how this activity encourages collaboration between peers. Regarding the teaching staff's motivation, active intervention and constant feedback from the lecturer/professor is considered necessary in order to carry out an autonomous, shared, and critical learning process [8–10]. Similarly, Figure 4 shows that the subjects in which the best CLA grades are obtained coincide with those in which students claim to be more motivated, DOM, PE, and PEDR. As noted by other authors [62–64], students retain more knowledge in cooperative learning situations, as they have to explain it to others. In addition, the fact that they have to learn something efficiently in order to explain it and teach it to others enables them to learn in a more reflexive and critical way [40,51,65].

In addition, the study also detected that students perceived an improved understanding of the subject and were more motivated as a result of carrying out CLA. Along these lines, Tran [33] and Laguador [28] point out that when students perceive an improvement in their learning within a cooperative context, their attitude towards learning also improves. Likewise, in the second varifactor obtained through the PCA, the fact that the CLA makes the student more participatory (B12) correlated with his or her individual work and learning (B21, B23), the learning process itself (B22), feeling responsible for fellow students' learning (B24), and with a better use of time during learning (B27).

As expected, a correlation was observed between variables related to the functioning of the group such as feeling heard and listening to peers, stimulation of critical thinking, and the organization of the group itself. This suggests that the student feels that he or she is part of the group and that he or she can also take an active role in it. In contrast, Figure 4f shows that students in subjects where the group is formed by the teacher (MP) and who have worked in specific cooperative groups (MP and WSE) gave the items in block B3 (Team relationship) of the survey the lowest scores. These results highlight, among other studies, that cooperative learning creates positive interpersonal relationships which are

characterized by personal and academic support [3,4,14]. In this regard, promoting interaction within the group of students, fosters relationships through socialization and learning [66–68].

5. Conclusions

In this interdisciplinary study, we have analyzed how students from various university degrees have assessed their participation in cooperative learning activities. Overall, the results of this research show that these activities have enabled students to obtain better grades in their subjects. A questionnaire on aspects of learning such as motivation, degree of learning achieved, and interpersonal relationships was analyzed, and findings show that most students evaluate cooperative learning activities positively. This is because they feel more involved in the learning process, and thus a greater sense of responsibility towards their learning. Findings also show that higher student motivation is related to the activity being well organized as well as the degree of motivation students perceive from the teaching staff, and that this higher motivation in turn leads to a better rating of the activity. In addition, students consider that these activities encourage them to adopt a more active role in the classroom and that this in turn improves their learning process, increases the responsibility they assume for their fellow students' learning, and helps them use study time more efficiently. Finally, we also observed that these activities promoted positive interpersonal relationships between group members as well as with the teaching staff.

Moreover, results affirm that although there are slight differences in student satisfaction with cooperative activities, depending on the university degree where it is carried out, the overall results are positive. Thus, no limitations should be put on using this type of activity in any subject in a university degree course, as it provides a space where learning is promoted by fostering better social skills in students. It also teaches them the skills that will make them more competent in the workplace and gives them the opportunity to access better job opportunities in the 21st century work environment. Finally, results also pointed out that the degree of student satisfaction depended on factors such as the role taken by the teaching staff, how the activity is organized in class, the relationship between classmates, and the subject studied.

In summary, the main contribution of this study is that it has been shown that cooperative learning can be applicable to any university degree. The lowest percentages of student satisfaction have been obtained for those subjects in which, traditionally, this type of learning is less employed, reinforcing the idea that cooperative learning cannot be done on an on-off basis, but a process is needed for the student to learn to cooperate. Based on all the above, universities should strongly consider adopting it as a teaching methodology because it leads to more creative, flexible, critical, and innovative people, essential values for citizens of the 21st century. We would like to mention that a limitation of the current study is the size of the sample, which will be enlarged in future studies.

Author Contributions: Conceptualization, D.C. and J.S.-P.; methodology, all; validation, all.; formal analysis, A.M.; investigation, all; resources, all; data curation, all; writing—original draft preparation, all; writing—review and editing, D.C.; visualization, A.M.; supervision, D.C. and M.P.; project administration, D.C.; funding acquisition, all. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Institute of Sciences Education of the University of Girona, grant number XIDAC/02-2002.

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

References

1. Fuertes-Camacho, M.T.; Graell-Martín, M.; Fuentes-Loss, M.; Balaguer-Fàbregas, M.C. Integrating sustainability into higher education curricula through the project method, a global learning strategy. *Sustainability* **2019**, *11*, 767. [CrossRef]
2. Serdà, B.; Alsina, Á. Knowledge-transfer and self-directed methodologies in university students' learning. *Reflective Pract.* **2018**, *19*, 573–585. [CrossRef]

3. Johnson, D.W.; Johnson, R.T. An educational psychology success story: Social interdependence theory and cooperative learning. *Educ. Res.* **2009**, *38*, 365–379. [CrossRef]
4. Colomer, J.; Serra, L.; Cañabate, D.; Serra, T. Evaluating Knowledge and Assessment-Centered Reflective-Based Learning Approaches. *Sustainability* **2018**, *10*, 3122. [CrossRef]
5. Ferreira, J.; Ryan, L.; Tilbury, D. *Whole-School Approaches to Sustainability: A Review of Models for Professional Development in Pre-Service Teacher Education*; Australian Government Department of the Environment and Heritage and the Australian Research Institute in Education for Sustainability (ARIES), Macquarie University: North Ryde, Australia, 2006; ISBN 1741381797.
6. Tejedor, G.; Segalàs, J.; Barrón, A.; Fernández-Morilla, M.; Fuertes, M.T.; Ruiz-Morales, J.; Gutiérrez, I.; García-González, E.; Aramburuzabala, P.; Hernández, À. Didactic strategies to promote competencies in sustainability. *Sustainability* **2019**, *11*, 2086. [CrossRef]
7. Loughran, J.J. Effective reflective practice: In search of meaning in learning about teaching. *J. Teach. Educ.* **2002**, *53*, 33–43. [CrossRef]
8. Chen, W. Description of an expert teacher's constructivist-oriented teaching: Engaging students' critical thinking in learning creative dance. *Res. Q. Exerc. Sport* **2002**, *72*, 366–375. [CrossRef]
9. Altun, S. The Effect of cooperative learning on students' achievement and views on the science and technology course. *Int. Electron. J. Elem. Educ.* **2015**, *7*, 451–468.
10. Cobas, M.E. A propósito del aprendizaje cooperativo. *Actual. Juríd. Iberoam.* **2016**, *4*, 154–175.
11. Muñoz, J.M.; Hinojosa, E.F.; Vega, E. Opiniones de estudiantes universitarios acerca de la utilización de mapas mentales en dinámicas de aprendizaje cooperativo. Estudio comparativo entre la Universidad de Córdoba y La Sapienza. *Perf. Educ. XXXVIII* **2016**, *153*, 136–151.
12. Cañabate, D.; Rodriguez, D.; Zagalaz, M.L. Physical education and dance: Assessment of inclusion and development in primary schools in Girona province. *Apunts. Educ. Fís. Deport.* **2016**, *125*, 53–62. [CrossRef]
13. Cañabate, D.; Serra, T.; Bubnys, R.; Colomer, J. Pre-service teachers' reflections on cooperative learning: Instructional approaches and identity construction. *Sustainability* **2019**, *21*, 5970. [CrossRef]
14. Cañabate, D.; Colomer, J.; Olivera, J. Movement: A language for growing. *Apunts. Educ. Fís. Deport.* **2018**, *134*, 146–155. [CrossRef]
15. Ruda, A.; Cañabate, D.; Curós, P.; García-Romeu, M.L.; Planas, M.; Sidera, F.; Ministral, M.; Sidera, F.; Vidal, O. *Guia Sobre Aprenentatge Cooperatiu*; Universitat de Girona, Servei de Publicacions: Girona, Spain, 2013.
16. Slavin, R.E. PET and the pendulum: Faddism in education and how to stop it. *Phi Delta Kappan* **1989**, *70*, 752–758.
17. Slavin, R.E. Cooperative Learning and Academic Achievement: Why Does Groupwork Work? *Ann. Psychol.* **2014**, *30*, 785–791. [CrossRef]
18. Johnson, D.W.; Johnson, R.T.; Smith, K.A. Cooperative learning: Improving university instruction by basing practice on validated theory. *J. Excell. Coll. Teach.* **2014**, *25*, 85–118.
19. Johnson, D.W.; Johnson, R.T. *Learning Together and Alone: Cooperation, Competition and Individualization*, 3rd ed.; Englewood Cliffs (Nueva Jersey): Prentice Hall, NJ, USA, 1991.
20. Johnson, D.W.; Johnson, R. *My Mediation Notebook*, 4th ed.; Interaction Book Company: Edina, MN, USA, 2010.
21. Pujolàs, P. Nueve ideas clave. In *El Aprendizaje Cooperativo*; Graó: Barcelona, Spain, 2008.
22. Adu, E.O.; Galloway, G. The Effects of Cooperative Learning on Students' Economics Achievement and Attitude towards Economics. *J. Econ.* **2015**, *6*, 30–36. [CrossRef]
23. Bayraktar, G. The effect of cooperative learning on students' approach to general gymnastics course and academic achievements. *Educ. Res. Rev.* **2011**, *6*, 62–71.
24. Keramati, M. Effect of Cooperative Learning On Academic Achievement of Physics Course. *J. Comput. Math. Sci. Teach.* **2010**, *29*, 155–173.
25. Slavin, R.E.; Hurley, E.A.; Chamberlain, A. Cooperative learning and achievement: Theory and research. In *Handbook of Psychology*; Reynolds, W., Miller, G., Eds.; John Wiley: New York, NY, USA, 2003; Volume 7, pp. 177–198.
26. Kaufman, D.; Sutow, E.; Dunn, K. Three Approaches to Cooperative Learning in Higher Education the Canadian Journal of Higher Education. *Rev. Can. Enseign. Supér. XXVII* **1997**, *2*, 37–66.

27. Ayllón, S.; Alsina, Á.; Colomer, J. Teachers 'involvement and *Supérieur* students' self-efficacy: Keys to achievement in higher education. *PLoS ONE* **2019**, *14*, e0216865. [CrossRef] [PubMed]
28. Laguador, J.M. Cooperative learning approach in an outcomes-based environment. *Int. J. Soc. Sci. Arts Humanit.* **2014**, *2*, 46–56.
29. Keramati, M. Effect of cooperative leaning on academic achievement of physics course. *J. Psychol. Educ. Sci.* **2001**, *31*, 139–155.
30. Lavasani, M.G.; Khandan, F. The effect of cooperative learning on mathematics anxiety and help seeking behavior. *Procedia Soc. Behav. Sci.* **2011**, 15271–15276. [CrossRef]
31. Metzler, M.W. *Instructional Models for Physical Education*; Holcomb Hathaway: Scottsdale, AZ, USA, 2011.
32. Quinn, M.M. Changing antisocial behavior patterns in young boys: A structured cooperative learning approach. *Educ. Treat. Child.* **2002**, *25*, 4380–4395. [CrossRef]
33. Tran, D. The Effects of Cooperative Learning on the Academic Achievement and Knowledge Retention. *Int. J. High. Educ.* **2014**, *3*, 131–140. [CrossRef]
34. Colomer, J.; Serra, T.; Cañabate, D.; Bubnys, R. Reflective learning in higher education: Active methodologies for transformative practices. *Sustainability* **2020**, *12*, 3827. [CrossRef]
35. Cañabate, D.; Santos, M.; Rodríguez, D.; Serra, T.; Colomer, J. Emotional self-regulation through introjective practices in physical education. *Educ. Sci.* **2020**, *10*, 208. [CrossRef]
36. Slavin, R.E. Neverstreaming: Preventing learning disabilities. *Educ. Leadersh.* **1996**, *53*, 4–7.
37. Johnson, D.W.; Johnson, R.T. The impact of cooperative, competitive, and individualistic learning environments on achievement. In *International Handbook of Student Achievement*; Hattie, J., Anderman, E., Eds.; Routledge: New York, NY, USA, 2013; pp. 372–374.
38. Johnson, R.T.; Johnson, D.W. Una visió global de l'aprenentatge cooperatiu. *Suports Rev. Catalana Educ. Espec. Atenció Divers.* **1997**, *1*, 54–64.
39. Tombak, B.; Altun, S. The Effect of Cooperative Learning: University Example.Eurasian. *J. Educ. Res.* **2016**, *16*, 173–196. [CrossRef]
40. Slavin, R.E. *Student Team Learning: A Practical Guide to Cooperative Learning*, 3rd ed.; National Education Association: Washington, DC, USA, 2011.
41. Johnson, D.W.; Johnson, R.; Holubec, E. *Cooperation in the Classroom*, 9th ed.; Interaction Book Company: Edina, MN, USA, 2013.
42. Byra, M. *Reciprocal Style of Teaching: A Positive Motivational Climate*; Comunicación Presentada al AIESEP World Congress: Jyväskylä, Finland, 2006.
43. Johnson, D.W.; Johnson, R.T.; Stanne, M.B. *Cooperative Learning Methods: A Meta-Analysis*; Cooperative Learning Center at the University of Minnesota: Minnesota, MN, USA, 2000.
44. Vygotsky, L. *Pensamiento y Lenguaje*; La Pléyade: Buenos Aires, Argentina, 1973; pp. 12–323.
45. Gillies, R.M.; Boyle, M. Teachers' reflections on cooperative learning: Issues of implementation. *Teach. Teach. Educ.* **2010**, *26*, 933–940. [CrossRef]
46. Johnson, D.; Johnson, R.T. The use of cooperative procedures in teacher education and professional development. *J. Educ. Teach.* **2017**, *43*, 284–295. [CrossRef]
47. Cañabate, D. *L'ensenyament i Aprenentatge de la Cooperació a l'aula: Estudi d'un cas a l'educació Primària*; University of Girona: Girona, Spain, 2008.
48. Page, A. Implementing cooperative learning: A consideration of barriers and enablers. *J. Init. Teach. Inq.* **2017**, *3*, 49–52. [CrossRef]
49. Cañabate, D.; Nogué, L.; Serra, T.; Colomer, J. Supportive peer feedback in tertiary education: Analysis of pre-service teachers' perceptions. *Educ. Sci.* **2019**, *9*, 280. [CrossRef]
50. Cañabate, D.; Martínez, G.; Rodríguez, D.; Colomer, J. Analysing emotions and social skills in physical education. *Sustainability* **2018**, *10*, 1585. [CrossRef]
51. Sousa Santos, B. *Renovar la Teoría Crítica y Reinventar la Emancipación Social*; Red de Bibliotecas Virtuales de Ciencias Sociales de America Latina y el Caribe, de la Red de Centros Miembros de Clacso: Buenos Aires, Argentina, 2006.
52. Heredia, J.; Duran, D. Aprendizaje cooperativo en educación física para atender a la diversidad: Inclusión de alumnado con rasgos autistas. *Rev. Nac. Int. Educ. Incl.* **2013**, *6*, 25–40.
53. Lata, S.; Castro, M. El Aprendizaje Cooperativo, un camino hacia la inclusión educativa. *Rev. Complut. Educ.* **2016**, *27*, 1085–1101. [CrossRef]

54. Azorín, C. El método de aprendizaje cooperativo y su aplicación en las aulas. *Perf. Educ. XL* **2018**, *161*, 181–194. [CrossRef]
55. García-Ruiz, M.R.; González Fernández, N. El aprendizaje cooperativo en la universidad. valoración de los estudiantes respecto a su potencialidad para desarrollar competencias. *Rev. Iberoam. Investig. Desarro. Educ.* **2012**, *4*, 106–128. [CrossRef]
56. Aramendi, P.; Bujan, K.; Garín, S.; Vega, A. Estudio de caso y aprendizaje cooperativo en la universidad. *Profr. Rev. Curríc. Form. Profr.* **2014**, *18*, 412–429.
57. Salehizadeh, M.R.; Behin-Aein, N. Effects of cooperative learning plus inquiry method on student learning and attitudes: A comparative study for engineering economic classrooms. *Eur. J. Eng. Educ.* **2013**, *38*, 23–35. [CrossRef]
58. Johnson, D.; Johnson, R. *Learning Together and Alone. Cooperative, Competitive and Individualistic Learning*; Allyn and Bacon: Needham Heights, MA, USA, 1991.
59. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E.; Tatham, R.L. Multivariate Data Analysis with Readings. *Englewood Cliffs* **1998**, *3*, 207–219.
60. Jolliffe, T. *Principal Component Analysis*; Springer Series in Statistics; Springer: New York, NY, USA, 2002.
61. Velázquez, C. Aprendizaje cooperativo en Educación Física: Estado de la cuestión y propuesta de intervención. *Retos Nuevas Tend. Educ. Fís. Deport. Recreación* **2015**, *28*, 234–239.
62. Zakaria, E.; Chin, L.C.; Daud, M.Y. The effects of cooperative learning on students' mathematics achievement and attitude towards mathematics. *J. Soc. Sci.* **2010**, *6*, 272–275. [CrossRef]
63. Webb, N.M. Learning in small groups. In *21st Century Education: A Reference Handbook*; Good, T.L., Ed.; Sage: Los Angeles, CA, USA, 2008; pp. 203–211.
64. Johnson, D.W.; Johnson, R.T. *Cooperation and Competition: Theory and Research*; Interaction Book Company: Edina, MN, USA, 1989.
65. Kagan, S.; Kagan, M. *Kagan's Cooperative Learning*; Kagan Publishing: San Clemente, CA, USA, 2009.
66. Díaz-Iso, A.; Eizaguirre, A.; García-Olalla, A. Extracurricular Activities in higher dducation and the promotion of reflective learning for sustainability. *Sustainability* **2019**, *11*, 4521. [CrossRef]
67. Ayers, J.; Bryant, J.; Missimer, M. The Use of reflective pedagogies in sustainability leadership education—A case study. *Sustainability* **2020**, *12*, 6726. [CrossRef]
68. Liesa-Orús, M.; Latorre-Cosculluela, C.; Vázquez-Toledo, S.; Sierra-Sánchez, V. The technological challenge facing higher education professors: Perceptions of ICT tools for developing 21st century skills. *Sustainability* **2020**, *12*, 5339. [CrossRef]