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Towards a Cooperative Learning Environment in Universities through In-Service Training

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Abstract: The goal of this study is to determine the extent to which faculty training in cooperative learning (CL) transfers to university teaching, according to students' opinions. The design was quasi-experimental, with a control group and an intervention group. During two years, 346 first-year university Business School students and 12 university teachers of four disciplines (Business and Economy, Communication, Mathematics and Knowledge Integration) took part in the study. The results show that, after specific training in CL methodology, teachers showed significant improvement in the application of several CL dimensions: social skills, evaluation, reflection, interdependence, interaction and tutoring. In addition, a multivariate analysis of variance was calculated to examine the possible interaction effect of teacher training and disciplines on CL application. The results indicate that training based on participants' needs and context fosters transference to university teaching. Teachers from different disciplines respond differently when applying CL to the classroom after training, especially in evaluation, heterogeneity, and tutoring. The results highlight the importance of a quality faculty professional development program.

Keywords: cooperative learning; faculty professional development; higher education; transfer of training

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1. Introduction

One of the goals of sustainable development set by the United Nations [1] is to improve the quality of education. Teaching is a relevant factor of quality because, on the one hand, it reflects the psycho-pedagogical bases of the curriculum [2] and, on the other hand, it influences on students' learning. Therefore, to reach this goal, teacher training and qualification are required [2–5].

The effect of faculty training on teachers' learning and transfer is one of the main disciplines of interest for training managers, trainers, and staff themselves [6] due, among other reasons, to the growing investment in training made by universities [7,8].

Regarding teacher learning, several studies show evidence that training provides teachers with new knowledge on the subject they teach [9]. Furthermore, training improves teachers' psycho-pedagogical understanding and modifies their beliefs on the role of education as a tool for learning [10]. Besides, teachers' education fosters staff awareness of the value of active learning to achievement [11]. In addition, training increases teachers' self-efficacy to rigorously implement a variety of teaching strategies [9,12].

Referring to in-service training transfer, Blume, Ford, Baldwin and Huang [13] carried out a meta-analytic review about factors that predict or moderate transfer, defined as the implementation of learning in diverse instructional contexts. The authors identified some strategies that foster transfer, such as a spatial–temporal proximity between training and implementation. Besides, they encountered a lack of studies that considered training goals as transfer evaluation criteria.

Indeed, the evaluation of training has frequently focused on the satisfaction of participants instead of assessing the implementation of learning in teaching [14–17]. There are few studies that analyze the impact of faculty education on teaching [18] and that identify factors that favor or hinder the transfer of staff training to the classroom. Finally, there are even fewer studies that analyze the adequacy of classroom implementation of what was learnt in training [13].

Feixás, Fernandez, Lagos, Quesada and Sabaté [19] carried out a study in 18 Spanish universities and found that training design is the most important facilitating factor for transfer. They identified some specific features of teacher education that foster transfer: taking into account the participants' context; being aware of the common practices of the teachers; generating some tangible products to be applicate to the courses taught by the participants. (e.g., a teaching program). In the same vein, Huang, Blume, Ford, and Baldwin (2015) [20] found that workplace support is a strong predictor of transfer, along with teachers' motivation to implement it in the classroom.

It is even harder to find studies on the transfer of training about a specific teaching approach as cooperative learning (CL). CL is a generic term used to refer to several techniques for organizing and conducting classroom instruction in small, heterogeneous groups in order to achieve common learning goals [21,22]. The success of cooperation depends on the nature of the interaction [23]. In this sense, when implementing CL it is important to consider the following features [21,24,25]: (a) positive interdependence, each member of the group is successful if the rest of the group is also successful; (b) interaction, students in a group help and support each other; (c) social skills are key to making decisions, to solving conflicts, to organizing tasks, etc.; (d) group reflection fosters group members' awareness of the team's progress and the difficulties they face; (e) heterogeneity, diversity enables students to value different perspectives.

Assuming these characteristics as core for cooperation, different cooperative learning techniques have been developed [26] such as Jigsaw [27,28], Learning Together [29], Constructive Controversy [21,29], Group Investigation [30], Co-op Co-op [31], and Teams-Games-Tournament [32].

Regardless of the technique, research has confirmed that CL fosters the development of competences included as instructional goals in most university curricula, such as competence to learn and teamwork [33]. Besides, CL contributes to students' achievement, self-perceived success and satisfaction with learning [34,35]. In fact, collaboration is a core feature of active learning techniques such as project-based learning, problem-based learning, case studies and research-based learning, among others [36].

Recent studies show that the development of cooperation is associated with the development of competencies for sustainability [37], with mutual benefit between genders [38] and specifically with the pre-service and in-service training of teachers who develop their own cooperative competencies [39].

However, despite the benefits of cooperative learning [40–44], its use is not extensive in higher-education [45] because of, among other reasons, a lack of staff expertise [46]. Therefore, to increase the use of CL at university, effective specific training is required.

Consequently, this study pursues two objectives. The first one is to design and implement a training course in cooperative learning for university teachers, focusing on the core elements of CL more than on specific cooperative learning techniques. The second one is to analyze if, considering students' opinions, training participants then implement CL in their classrooms.

The hypotheses for this study were the following:

Hypothesis 1 (H1). *Training in CL has a positive influence on the development of a cooperative environment in the university classroom.*

Hypothesis 2 (H2). *The transferability of training in CL to the university classroom varies depending on teaching discipline.*

2. Materials and Methods

2.1. Context

The Business School at the Universidad de la Santísima Concepción (Chile), where this study was carried out, implemented a competence-based curricula plan in 2011, highlighting teamwork as a core competency. Consequently, the plan included several sequenced strategies to provide students training in teamwork skills, such as using CL in all first-year courses. Indeed, several studies have revealed that CL is effective in achieving this learning goal [41,47–49]. In order to make this action effective, the 12 lecturers that were going to teach the first-year courses took part in a CL-specific training course.

Three of the 12 lecturers belonged to Business and Economy discipline, two to Communication discipline, two to Mathematics discipline, and five to Knowledge Integration (KNI). The discipline of KNI encompasses two curricular activities for supplementary training (Table 1). Participants had, on average, 10 years of teaching experience.

Table 1. The distribution of subjects and disciplines taught by the teachers.

Teacher	Subject Taught	Discipline
1	Introduction to the degree	1: Business and econom
2	Communication for business	2: Communication
3	Mathematics for business	3: Mathematics
4	Stage expression	4: KNI
5	Mathematics for business	3: Mathematics
6	Self-management in learning	4: KNI
7	Communication for business	2: Communication
8	Self-management in learning	4: KNI
9	Introduction to the degree	1: Business and economy
10	Introduction to the degree	1: Business and economy
11	ICT Resources	4: KNI
12	Self-management in learning	4: KNI

Before training, an awareness session was conducted to make the lecturers aware of the relevance of CL for developing students' teamwork competence.

The training course was structured as four sessions spanning a total of 16 h. In addition, participants were supervised and supported during the implementation of CL in the university classroom.

The training course aimed to achieve the following specific goals:

- To experiment and identify the benefits of CL
- To reflect on the difficulties of teamwork
- To identify the relevant elements of cooperative learning
- To collaboratively plan a lesson/task/course
- To reflect on the plan, in order to improve it

The training course was designed taking into account the main guidelines for faculty in-service training [50] and following the experiential learning cycle [51]. Therefore, the training started by analyzing participants' needs and reflecting on one's own teaching practice. In this way, several activities were conducted to facilitate reflection among participants such as analyzing the difficulties of teamwork in the classroom, or completing the Cooperative Learning Application Scale (CLAS) [23] adapted for teachers' self-assessment. The conceptualization phase of the cycle was carried out through a combination of explanations by the trainer and cooperative tasks for the search, analysis and presentation of information using Jigsaw as a specific cooperative technique. Finally, the main activity during the experimentation phase was planning a subject/lesson/session meeting the required elements of cooperation.

Furthermore, training was conducted in a cooperative context, which allowed participants learn from their own training experience, by ensuring the essential elements of cooperation: positive interdependence, individual responsibility, interaction, social skills, and group reflection on the process [52].

2.2. Participants

The participants in this study were students in their first year of the degrees Business Administration and Accountancy-Auditing degrees at the Faculty of Economics and Administrative Sciences of a Chilean university, and they belonged to two cohorts: group 1 (G1) belonged to the 2015 cohort, and were first-year students when the teachers had not yet received training in cooperative methodology; and group 2 (G2) belonged to the 2016 cohort, who were first-year students when the teachers had already been trained in CL. Both groups exhibited similar socio-demographic characteristics.

G1 comprised 157 students, 46% of whom were women and 54% men; the average age was 18 years in both groups. Their average score in the university entrance exam was 570.273, ranging from 150 to 850 points; 78.4% of the students belonged to Business Administration, and 21.6% to Accountancy-Auditing.

In G2, 189 students were queried, of whom 48.2% were women and 51.8% were men. Their average score in the university entrance exam was 570.273; 69.8% belonged to Business Administration and 30.2% pursued a degree in Accountancy-Auditing.

2.3. Procedure

A quasi-experimental design was used, with G2 as the intervention group and G1 as the control group (see Figure 1). The similarity between the students in both groups at the time of admission controlled for confounding variables and allowed for a comparison between both groups for the chosen variable. The intervention consisted of a training course in CL methodology for the teachers.

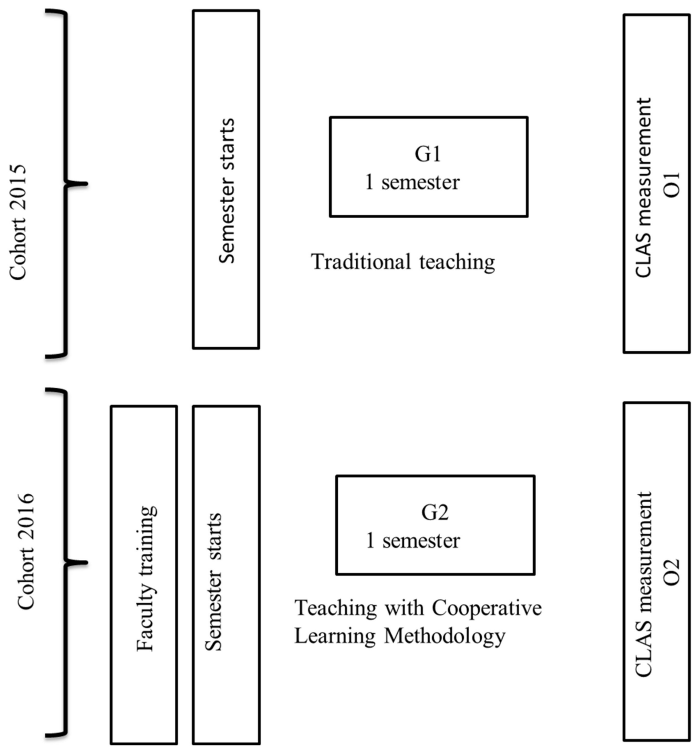

Figure 1. Description of the methodologic design.

After obtaining informed consent, the CLAS scale was applied to G1 students in July 2015—at the end of the first semester in the Chilean higher-education system—in order to gain insight into their perception of the implementation of CL elements by their 12 teachers in that teaching period (O1).

Subsequently, before the start of the first semester of 2016, in January, the 12 teachers took part in a training course in cooperative methodology. Finally, in July 2016, at the end of the semester, the CLAS scale was applied (O2) to G2.

2.4. Instrument

In order to measure the degree of implementation of CL, the Cooperative Learning Application Scale (CLAS) was used [23]. It is a scale of 44 Likert type items with values ranging 1 to 4, which assesses seven dimensions of cooperative methodology: evaluation (EVA), heterogeneity (HET), social skills (SK), interactions (INTERA), positive interdependence (INTER), group reflection (REFL) and tutoring (TUTOR). Heterogeneity is related to the in-group level of diversity regarding skills, sex, ethnicity etc. Social skills are needed to make decisions, build trust, communicate appropriately, organize efficiently, etc. Interactions refers to an active learning environment where all students support each other. Positive interdependence involves the perception by all group members that they cannot achieve their goals if the others do not achieve theirs. Group reflection or joint assessment by group members of the learning process carried out, allows them to be aware of the strengths and weaknesses of the group, as well as the advances and setbacks. Tutoring refers to the support provided by the teacher in order to foster the development of the group task, and must foster autonomy for learning. This instrument was validated on a sample of students from a Spanish and a Chilean university with an admission profile similar to that of the university where this study has been conducted [23]. Results showed Cronbach's alpha internal consistency coefficients between 0.7 and 0.87, greater than the value of 0.7 recommended in scientific literature [53]. Furthermore, the model fit was adequate, its Root Mean Squared Error of Approximation (RMSEA) coefficient being lower than 0.042 for both samples and its Comparative Fit Index (CFI) coefficient equaling 1.

2.5. Analysis

The process of analysis was carried out in five steps:

1. Univariate descriptive data were analyzed for each CLAS variable.
2. An analysis was conducted on the model measure of the scale to determine its degree of reliability and validity.
3. In line with the data distribution, a non-parametric test was calculated to contrast the differences that the training in cooperative learning had caused on each teacher's implementation of the CLAS dimensions.
4. A multivariate analysis of variance (MANOVA) was carried out to examine the possible interaction effect caused by the training and the disciplines of the teachers (Business and Economy, Communication, Mathematics, and Knowledge Integration) on the CLAS dimensions. In other words, an analysis was done to determine whether there were any differences in the implementation of CL when considering jointly the disciplines and the presence or absence of specific training. G1 is the group of teachers before training and G2 the group after training.
5. A two-step post-hoc analysis was calculated to examine the specific behavior for each discipline. The MANOVA analysis allowed us to contrast whether there were any significant differences between the disciplines as they interacted with the effect of the training. Additionally, the post hoc analysis provides insight into the disciplines that show differences depending on the presence or absence of training.

3. Results

3.1. Descriptive and Non-Parametric Analyses

For each dimension in the CLAS scale in each group, means, standard deviations, asymmetry and kurtosis were analyzed (see Table 2).

Table 2. The descriptive results of the scale dimensions for G1 and G2 (NG_1 = 157, NG_2 = 189).

Year/Variable	*M* O1	*M* O2	SD O1	SD O2	ASYM O1	ASYM O2	Kurtosis O1	Kurtosis O2
HET	3.48	3.52	0.43	0.47	−0.96	−1.2	0.67	1.73
SK	3.47	3.54	0.37	0.36	−0.67	−0.97	0.02	0.73
EVA	3.47	3.50	0.36	0.37	−0.61	−0.91	0.11	0.94
REFL	3.32	3.42	0.45	0.41	−0.65	−0.73	−0.09	−0.01
INTER	3.39	3.49	0.41	0.39	−0.84	−1.17	0.79	1.02
INTERA	3.53	3.67	0.37	0.35	−0.63	−1.46	−0.53	2.04
TUTOR	3.41	3.53	0.45	0.41	−0.77	−0.97	0.09	0.46
TOTAL	3.44	3.53	0.37	0.35	−0.59	−1.01	−0.28	0.736

Note: *M* (mean), SD (standard deviation), ASYM (asymmetric).

A general increase was observed in the mean score of the dimensions in O2 when compared to O1. The standard deviation did not show any important variations and remained similar in all seven dimensions for both groups. The Kolmogorov–Smirnov test for data normality proved significant for all the analyzed dimensions in both groups, which means that the data did not follow a normal distribution. The assumption of homoscedasticity, or variance homogeneity, was confirmed for dimensions HET [F(1, 967) = 3.05, p = 0.11]; SK [F(1, 967) = 3.94, p = 0.05]; and EVA [F(1, 967) = 0.97, p = 0.32]. It could not be confirmed for the other dimensions. The effect of the homoscedasticity of the variances on the results of ex post analysis of variance is mitigated in that the samples are similar in size. If the samples comprise a similar number of subjects, even when the assumption of homoscedasticity is not met in the other variables, this will not have any impact on the result. According to Luque [54], a value of 2 is the maximum coefficient for the ratio between sample sizes; in our study, the effect of homoscedasticity should not have any influence on the F-statistics of the variance analysis, as the ratio coefficient between the samples is 1.2.

3.2. Instrument Validation

The analysis of the reliability and validity of the model measure was carried out through structural equation modeling (SEM) by means of the method of partial least squares (PLS). We used the software SmartPLS (2015) [55]. The validation process started with an analysis of the reliability of the items and the dimensions (the measure instruments are free of random errors) and validity (the dimensions have the capacity to show real differences between the objects as related to the characteristic being measured). As for the reliability or internal consistency of the indicators, the simple correlations between the indicators on the respective dimensions, the coefficients for Cronbach's alpha, rho_A, and the complex reliability index (CR), showed values greater than 0.7 (see Table 3). In the academic literature, this indicator has usually been determined to be the lower limit for the criteria used to measure the reliability of the scale [56]. Therefore, the scale is consistent and provides a rigorous evaluation of the latent variable.

In order to examine the convergent validity, an analysis of the average variance extracted (AVE) was used [57]. In our study, all coefficients exceed the minimum, set at 0.5. Therefore, we can conclude that the items in the dimensions measure the same underlying construct.

Table 3. Indicators for internal consistency and convergent validity.

Construct	CR	Alpha	Rho_A	AVE	Factorial Loads
HET	0.884	0.826	0.856	0.657	0.729–0.889 *
SK	0.911	0.884	0.881	0.591	0.733–0.832 *
EVA	0.872	0.826	0.814	0.533	0.688–0.808 *
REFL	0.925	0.906	0.922	0.679	0.784–0.861 *
INTER	0.931	0.915	0.909	0.639	0.775–0.817 *
INTERA	0.894	0.842	0.917	0.597	0.765–0.838 *
TUTOR	0.937	0.921	0.842	0.678	0.807–0.843 *
Total for the scale		0.933			

* $p < 0.001$.

After examining the results of the evaluation of the model measure, we can posit that the scale reflects the theoretical subdimensions of the construct, through the data extracted from the observations; the scores obtained in the scale accurately reflect the real differences between the objects regarding the characteristic being measured, with no random errors.

Lastly, in order to assess the general fit of the model, the Standardized Root Mean Square Residual (SRMR) indicator was measured [58], which helps assess the mean difference between the observed and the expected correlations as an absolute measurement of model fit. The SRMR value of the model was 0.064, and therefore smaller than 0.08, which indicates that the model is a good fit [53].

3.3. Non-Parametric Contrast

Table 4 shows the absolute value of the Z coefficient of the Mann–Whitney U test for mean differences between independent samples with non-parametric distribution, for each dimension in the CLAS scale, both globally and per teacher. A negative mean difference indicates an improvement in the scores of the sub-scale after training. The data show significant changes in the corresponding dimension after the training.

Table 4. The mean difference shows the differences per teacher and dimension between pre- (G1) and post-training (G2) averages. ∣Z∣ shows the significance of the differences in averages for each dimension and teacher.

Prof.		Dimension							
		HET	SK	EVA	REFL	INTER	INTERA	TUTOR	TOTAL
1	Mean diff	−0.42	−0.28	−0.22	−0.37	−0.57	−0.41	−0.46	−0.41
	∣Z∣	2.98 *	1.94	1.73	2.49 *	3.88 ***	2.52 *	3.18 ***	3.14 ***
2	Mean diff	−0.27	−0.28	−0.06	−0.47	−0.39	−0.36	−0.33	−0.32
	∣Z∣	1.91	1.90	0.85	2.70 *	2.57 *	2.36 *	1.93	2.17 *
3	Mean diff	−0.1	0.09	−0.05	0.00	−0.09	−0.08	0.21	0.01
	∣Z∣	0.92	0.83	0.72	0.23	0.58	1.21	2.49 *	0.303
4	Mean diff	0.02	−0.08	0.14	0.19	0.01	−0.02	0.44	0.14
	∣Z∣	0.15	0.08	0.64	1.35	0.21	0.302	2.62 *	1.17
5	Mean diff	0.23	0.14	0.41	0.11	0.05	−0.15	0.02	0.03
	∣Z∣	1.45	0.88	2.31 **	0.53	0.13	1.59	0.46	0.23
6	Mean diff	0.15	0.09	0.27	0.09	−0.04	−0.07	0.11	0.09
	∣Z∣	1.63	1.49	1.64	0.60	1.07	1.29	1.07	0.91
7	Mean diff	−0.22	−0.51	−0.31	−0.49	−0.55	−0.54	−0.81	−0.51
	∣Z∣	0.95	3.31 ***	1.55	2.51 *	3.61 ***	3.38 ***	3.73 ***	2.56 ***
8	Mean diff	−0.06	−0.06	−0.05	0.08	−0.05	−0.11	0.04	−0.03
	∣Z∣	0.20	0.26	0.22	1.24	0.25	0.57	0.80	0.65
9	Mean diff	0.32	0.16	−0.04	−0.05	0.16	0.18	−0.29	0.06
	∣Z∣	2.23 *	1.19	0.42	0.48	0.65	1.41	1.93	0.29

Table 4. *Cont.*

Prof.	Dimension								
		HET	SK	EVA	REFL	INTER	INTERA	TUTOR	TOTAL
10	Mean diff	−0.21	−0.28	−0.33	−0.31	−0.29	−0.39	−0.35	−0.32
	∣Z∣	2.32 *	3.91 ***	3.86 ***	3.21 ***	2.81 *	5.13 ***	4.16 ***	4.2 ***
11	Mean diff	0.25	0.09	−0.03	−0.05	0.03	−0.06	−0.13	−0.03
	∣Z∣	0.52	0.46	0.49	0.01	0.52	0.37	1.17	0.32
12	Mean diff	−0.06	−0.14	−0.19	−0.16	−0.14	−0.19	−0.13	−0.13
	∣Z∣	0.15	0.07	0.17	0.34	0.46	0.27	0.21	0.02
Total	Mean diff	−0.04	−0.07	−0.05	−0.11	−0.1	−0.14	−0.12	−0.12
	∣Z∣	0.94	2.49 *	1.95 *	2.49 *	4.52 ***	5.09 ***	3.16 ***	3.12 ***

Note: ∣Z∣ = absolute value for the Mann–Whitney U test, per dimension. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The results exhibit significant differences between G1 and G2 in all dimensions except for heterogeneity (HET); after training, implementation improves for nearly all dimensions of CL. At a descriptive level, all teachers in G2 are observed to have improved in at least one dimension. As for the statistical significance, teacher 10, who belongs to the discipline “Introduction to the degree” (see Table 1), shows significant change in all dimensions, whereas teacher 1, who belongs to the same category, shows significant change in 5 out of 7 dimensions. Four teachers belonging to the KNI discipline have not shown any significant improvement in any dimension.

3.4. Multiple Analysis of Variance (MANOVA)

The MANOVA considers simultaneously two independent, non-metric variables, which grants a global perspective that cannot be achieved individually through the isolated application of variables on a continuous output [59]. The goal is to analyze the combined effect of two variables (training, and the knowledge of the subject taught by the teacher) on the use of the CL methodology. The following expression represents the analysis being performed, where each observation i of the modality k (y_{ik}) is the result of an overall average (μ), of the effect of the treatment τ_k and of random error for observation i adjusted by means of the treatment level k (ε_{ik}):

$$\gamma_{ik} = \mu + \tau_k + \varepsilon_{ik}$$

As for the interaction effect, the equation would include the elements of modality i of factor A (α_i), and modality j of factor B (β_j), plus the interaction between levels i, j of factors A and B respectively, as well as the error ε. Factor A corresponds to training, whereas factor B represents teachers’ discipline of knowledge. The conjunction of both factors constitutes the interaction effect $A \times B$.

$$\gamma_{ik} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ik}$$

The results of the analysis (see Table 5) reveal that training has a significant effect on the scores of five out of the seven dimensions of CLAS. This result regarding the effect of training on the dimensions matches the results obtained from the non-parametric analysis (see Table 4), except for the EVA subscale, in which the difference is not statistically significant for the variate analysis but does prove significant for the non-parametric analysis. This inconsistency in the results is caused by the non-metric nature of the Mann–Whitney U test. Assuming normality and homoscedasticity, the MANOVA F statistic is more potent than the Mann Whitney U statistic. In our study, the EVA variable does not meet the assumption of normality, but it does meet the assumption of homoscedasticity (equality of variances).

Table 5. Multivariate analysis of variance, full factorial (MANOVA) (F(df)).

	Training	Discipline	Interaction Effect: Training * Discipline
HET	1.77 (1)	0.63 (3)	3.19 (3) *
SK	7.61 (1) *	9.27 (3) *	4.78 (3) *
EVA	2.42 (1)	1.75 (3)	7.15 (3) *
REFL	10.41 (1) *	3.02 (3) *	6.913 (3) *
INTER	124.56 (1) *	5.08 (3) *	5.81 (3) *
INTERA	24.39 (1) *	13.77 (3) *	1.96 (3)
TUTOR	7.57 (1) *	2.03 (3)	9.86 (3) *

* $p < 0.001$.

Significant differences were found between G2 and G1 from different disciplines for dimensions SK, REFL, INTER and INTERA post-intervention, but not so for dimensions HET, EVA and TUTOR. The results indicate the existence of an interaction effect between training and teaching discipline for all dimensions of CLAS, except for the INTERA dimension, where the differences proved non-significant. Thus, the effect of training on the implementation of CLAS dimensions is contingent on the discipline.

The results of the MANOVA show that the significance of the differences in dimensions HET and EVA varies where training and discipline interact. According to the results, the training influenced the degree of implementation of the dimensions of CL methodology, except for dimensions HET and EVA. The results also indicate that teachers' discipline of specialization did not impact the degree of implementation in these two dimensions. However, when examining the effects of interaction on dimensions HET and EVA, the difference becomes significant. Namely, dimensions HET and EVA do not show significant differences if the variables of training and discipline are considered separately, but they do show significant differences when their combined effect is considered. Therefore, it is essential to carry out an in-depth analysis that will provide insight into the effect of training when considering differences between disciplines.

3.5. Post-Hoc Analysis

The goal of this analysis was to examine the differences stemming from the joint consideration of both discipline and training (interaction effect). The statistics of Pillai's trace and Wilks' lambda are statistically significant ($p < 0.05$) when contrasting multivariate differences between groups, which shows that the different disciplines behave differently, and that the effect of training on the implementation of the CLAS dimensions is different depending on the discipline.

Table 6 includes the differences between possible discipline pairs, through the significance of Tukey's post-hoc HSD test. Discipline 3 (Mathematics) is the only discipline that proves significantly different from the rest in the SK, REFL, INTERA and INTER dimensions.

Table 6. Tukey's post-hoc HSD test for multiple comparisons per discipline.

Discipline	Discipline	HET	SK	EVA	REFL	INTER	INTERA	TUTOR
1	2	−0.004	0.002	0.001	−0.031	−0.027	−0.037	−0.011
2	3	0.489	0.215 *	−0.024	0.138	0.181 *	0.341 **	0.131
3	4	−0.079	−0.236 **	0.103	−0.151 *	−0.174 *	−0.239 **	−0.111
4	1	0.034	0.017	−0.077	0.042	0.019	−0.063	−0.008
1	3	0.044	0.218*	−0.025	0.108	0.154 *	0.303 **	−0.12
4	2	0.03	0.021	−0.078	0.012	−0.007	−0.101	−0.018

* $p < 0.05$, ** $p < 0.01$.

Figure 2 shows the marginal means for each group, in each discipline, for the INTER variable. The discipline of Mathematics shows a lower marginal mean compared to the other disciplines in G1 (control), and it exhibits a score virtually identical to those of other disciplines in G2 (intervention), which means it underwent a much greater change than other disciplines regarding the implementation of the INTER dimension.

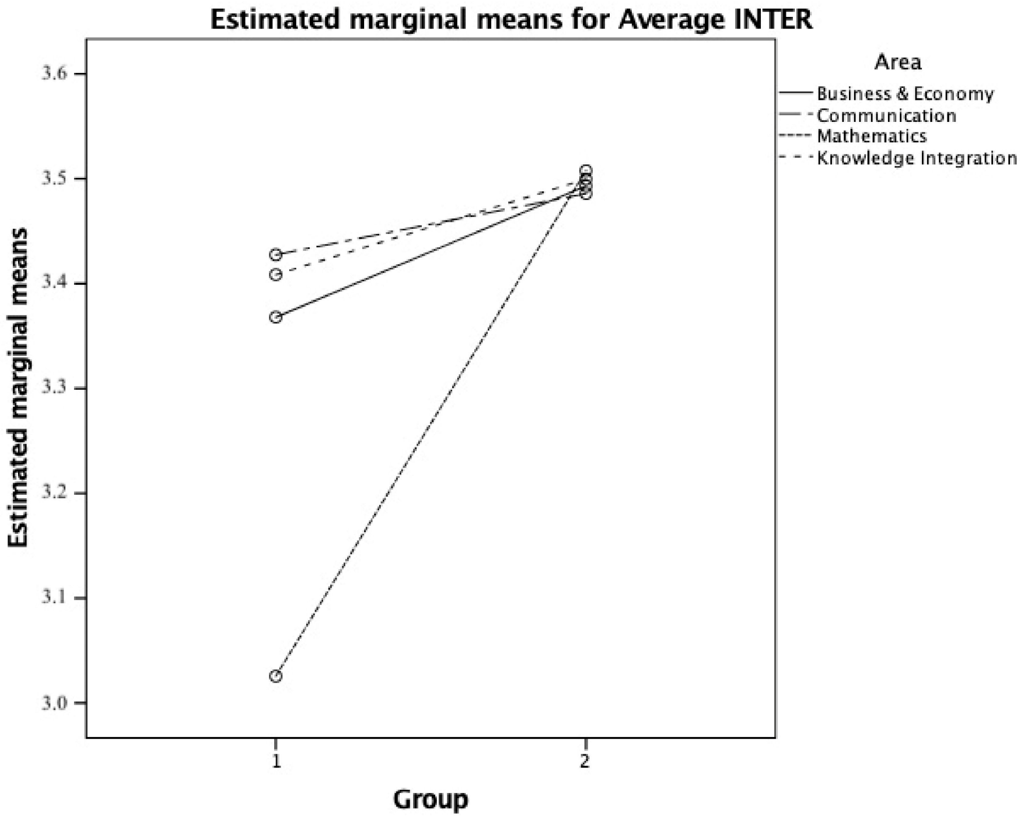

Figure 2. A graphical representation of means of the positive interdependence (INTER) variable in each group for each discipline.

This difference is also present in two other dimensions of the scale: REFL and SK (see Figures 3 and 4). For these dimensions, the discipline of Mathematics shows a below-average pre-training coefficient and an average post-training coefficient, which means Mathematics is the discipline with the largest percentage increase after training. This explains the significant differences on the interaction effect of the MANOVA: for dimensions INTER, REFL and SK, Mathematics was an discipline with a considerably lower marginal mean before training when compared to other disciplines, and thus the post-training improvement in this discipline has been the greatest, even though its mean has not exceeded that of other disciplines.

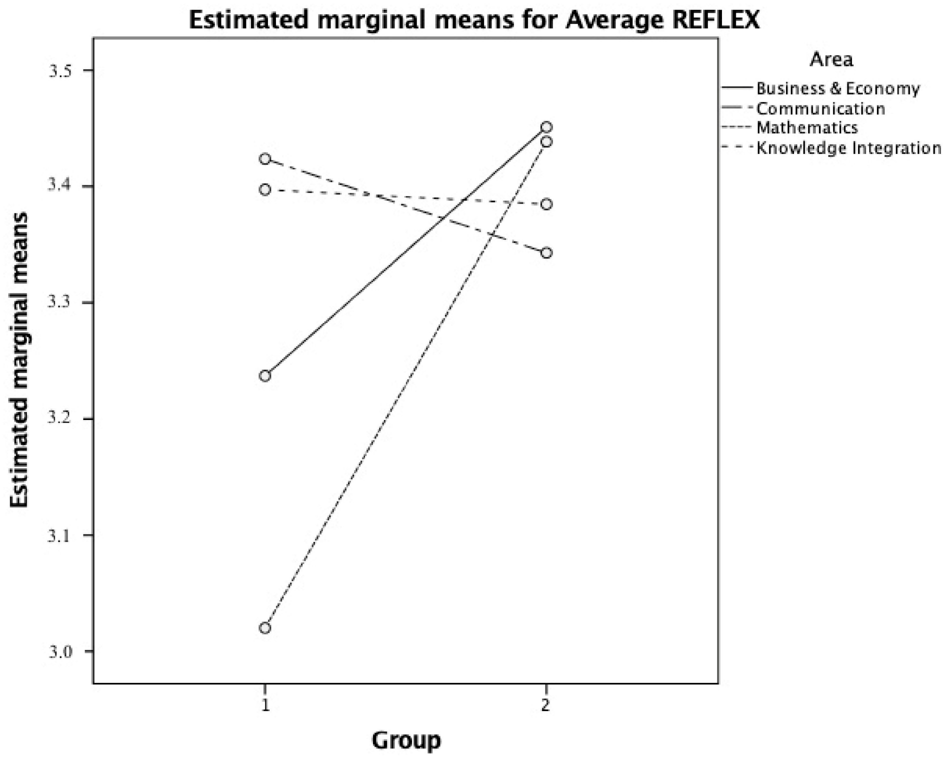

Figure 3. A graphical representation of means of the group reflection (REFL) variable in each group for discipline.

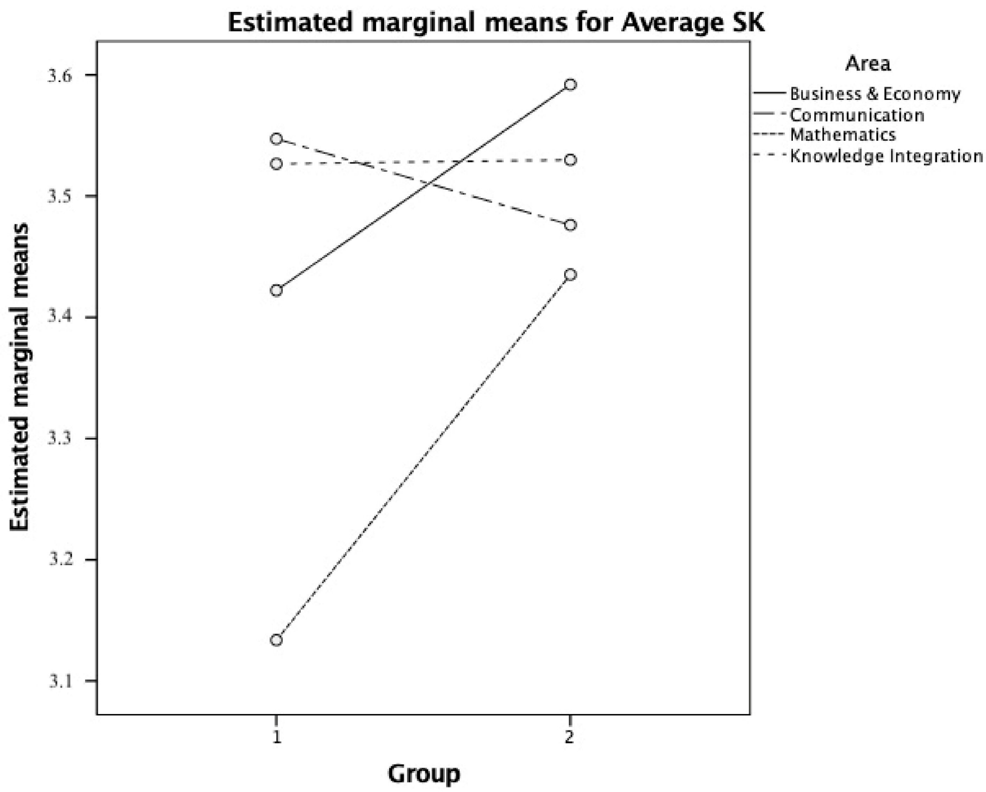

Figure 4. A graphical representation of means of the social skills (SK) variable in each group for each discipline.

4. Discussion

The main goal of this study was to know the effect of a CL training course on the university classrooms. The training focused on the cooperative methodology because of the potential of cooperation to foster the development of the competences, transversal or generic, required in university education [60] and necessary for professional performance, including critical thinking and, especially, teamwork [61].

To this effect, the training was devised and implemented taking into account the elements that facilitate transfer [19,62,63], such as experimentation, reflection and interaction. Thus, the training course was designed according to the specific needs of the participants [63] to foster experience-based learning [51,64]. Besides, the training course was designed to ensure both interaction and cooperation, providing the essential elements of cooperative learning [52]. As the research shows, the best strategy for teaching people to cooperate is cooperation itself [62,65].

In order to analyze the effect of faculty training on university instruction, a quasi-experimental design was conducted, gathering information in two stages: comparing two homogeneous (in demographic characteristics such as gender) groups before and after the CL training course. Homogeneity between groups is important because there is evidence of differences in the perception of CL utility by students of different genders [38]. The results indicate that nearly all elements of cooperative learning improved significantly after training: social skills, evaluation, reflection, interdependence, interaction and tutoring. The heterogeneity was the only aspect that did not show any significant changes.

Accordingly, the results show that the CL training course, based on the experiential learning cycle and on the experience of learning in a cooperative learning context, fosters transferability. Likewise, considering teachers' needs and context, along with participation, reflection, and dialogue, favors the effect of training on practice. The results are consistent with the conclusions by Blume et al. [13] and Feixas et al. [19].

Cooperative learning activities in the classroom after teacher training improve students' perceptions about cooperation between peers [66]. Indeed, the interaction and social skills dimensions are encouraged when cooperative activities are properly settled (Muñoz, Hinojosa, Vega (2016) [67]. In the same vein, interdependence improves when teachers design cooperative tasks considering all the interdependence requirements [68]. Besides, reflection evolves significantly after training. Then, spending time in classroom on group reflection activities improves social skills of university students [69].

Specifically, regarding cooperative techniques, Tan, Sharan, and Lee (2006) [70] show that group investigation, a technique widely used in higher education, improves students' perceptions of learning strategies and the teacher's role.

The absence of any significant post-training improvement in heterogeneity can be explained in the context of our study by the fact that teachers were not able to decide the composition of the student teams, because the groups had been created beforehand following administrative—and not academic—criteria. Therefore, change in this dimension could not be affected by the training provided to the teachers. These results confirm the importance of team composition in CL, as recognized by other authors [71], even though teaching practice shows that students frequently show reluctance to the extrinsic creation of work groups [72].

Considering teaching disciplines, the results show differences between teachers in the degree of post-training CL implementation. Specifically, teachers of the Economics and Business show significant changes in most dimensions of CL; this discipline was one of the disciplines where group strategies had been most widely implemented before training, which could have increased motivation to undertake CL training. In the same vein, Cañabate, et al. (2020) [66] state that previous exposure to this type of learning activity can foster the motivation to undertake this kind of learning. This could correlate with a better disposition towards implementing what was learned during training [20]. In the same vein, several studies conclude that the transfer of CL training is related to the teachers' attitudes towards teaching innovation [73].

Teachers belonging to different disciplines implement CL at different degree after training, especially in the dimensions of heterogeneity, evaluation and tutoring. Assuming that these elements are crucial to ensure that the group process unfolds properly [17] we can conclude that teaching discipline is a relevant contextual variable for training. As an example, teachers of Mathematics achieve lower initial scores when compared to teachers of other disciplines; this could be explained by the long-standing tradition of structuring its teaching around individual work, with collaborative tasks being infrequent [74]. Considering this initial difference, it comes as no surprise that, after training, teachers of Mathematics (G2) show a greater evolution in the implementation of CL when compared to teachers of other disciplines. Therefore, CL training has had the greatest impact on teachers of Mathematics, who had lower initial levels of experience and knowledge in CL [74].

This study provides a proposal for evaluating faculty training by shifting the focus from attendee satisfaction towards its effect on the improvement of university teaching, which is the ultimate goal of teacher training [14–17].

Additionally, the study provides insight into the effect of faculty professional training, gathering as evidence the point of view of the students taught by participating staff. Furthermore, several variables have been identified that influence the impact of training, including teaching discipline, which has not been widely researched yet [73]. Moreover, the impact of training has been assessed with a tool that measures the implementation of CL and whose factor structure had been previously validated [73]. Consequently, it has enabled the researchers to measure the effect of training on the implementation of each specific dimension of CL in university teaching.

For the above reasons, this study makes a significant contribution; there is scientific evidence of the benefits of CL on the social and academic learning of university students [15], but it is not always implemented with careful consideration for all the elements of cooperation. In this regard, the role of teachers is key, and it is therefore necessary to provide them with adequate training that has been proven to effectively improve teaching [63].

In this sense, this study has important practical implications for training. It is suggested that for training to be effective, it must be designed considering the context, the teachers' needs, and discipline. Besides, teachers' reflection and collaboration favors transferability to teaching practice. Another important implication is that the correct application of team-based methodologies, specifically cooperative learning, in university classrooms is key to developing student teamwork, a core competency within university education [66,75]. Indeed, teamwork skills are crucial for employability and for the sustainable management of human resources.

However, to learn to cooperate it is not enough to require student to work in groups. Teachers should ensure the conditions for genuine cooperation [76,77]. Therefore, educational institutions should invest efforts in specific training in CL to foster its correct application to the university classroom [78].

Despite the contribution, some limitations of the study must be considered. On the one hand, it has not been possible to carry out an experimental design, as student groups were configured at the time of enrolment in university studies. Additionally, it has not been possible to conduct a longitudinal study, and thus the control and experimental group belong to two different cohorts, albeit ones sharing very similar sociodemographic characteristics. Therefore, it would be interesting to continue with longitudinal studies that would allow us to test the evolution of the ensemble of dimensions.

Replication through future studies would allow for the results to be compared, in order to confirm our findings; it would also be desirable to study the impact of CL training by analyzing not only the change in teaching but also the effect on students' learning and development, which is the ultimate goal of university education [13,15,63].

Likewise, it would be advisable to analyze the effect of training in diverse CL techniques and various teaching strategies other than CL as well as to identify the training characteristics that foster or hinder their transfer to university classroom. Furthermore, since research confirms differences by gender in the valuation of cooperative learning contexts [38] it would be interesting to further analyze the role of this variable in the transferability of training in CL to teaching.

5. Conclusions

The study has led us to the following conclusions:

In-service training that is based on faculty's needs and adapted to staff's context is transferable to university teaching, most probably because it improves faculty´s attitudes towards training [64].

Training that includes aspects such as participation, reflection and interaction has a positive impact on the quality of university teaching.

The validity and consistency of university teacher training facilitates transfer to university teaching. In this study, the specific CL training course that was created, was based on the dimensions of cooperation [52] which allowed attendees to learn in a cooperative environment, experiencing collaboration and gaining first-hand knowledge of its benefits for the learning process.

Among all dimensions of CL, heterogeneity is the dimension showing the lowest degree of transfer. This result can be explained by the small impact of teachers on group configuration, as groups were created beforehand by university administrators. Considering the importance of this dimension, heterogeneity should be considered when implementing CL.

One of the key contextual aspects influencing the transferability of CL training to university teaching is discipline. In our case, the largest evolution has taken place in Mathematics; cooperation and collaboration have traditionally been used less frequently in this area than in others.

Summarizing, this study asserts that the role of the teacher is crucial in setting up a cooperative environment. Therefore it is important that staff receive quality training that can then be transferred to teaching. In this regard, we have confirmed the impact of training based on the context and the needs of teachers that allows them experience cooperation while learning. Since the transfer of teacher training into practice is not an automatic process, especially if the training is not of sufficient quality [79], this study provides scientific evidence to increase the impact of training on the improvement of education, thus increasing the sustainability of teachers' professional development.

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