Project-Based Learning (PBL) and Its Impact on the Development of Interpersonal Competences in Higher Education

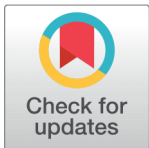Paula Crespí[1] , José Manuel García-Ramos[2] and Marián Queiruga-Dios[3]

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ABSTRACT

In response to globalisation, and the cultural, socio-economic, and educational changes it implies, higher education must offer a comprehensive education that favours personal and professional growth. To do this, it must promote competence-based learning through active teaching methodologies. This study will analyse the use of Project-Based Learning (PBL) methodologies in the context of transversal subjects, as an efficient technique to develop interpersonal communication and teamworking skills. This research is quasi-experimental, with a pre-test/post-test design with an equivalent control group. The sample consists of 610 university students from the Community of Madrid, of whom 387 participated in the PBL (Experimental Group: EG) and 223 did not (Control Group: CG). A reliable and validated questionnaire on personal competences was used as a measurement instrument. The hypotheses on the effectiveness of PBL as a technique for the development of interpersonal communication and teamworking skills in the context of transversal subjects are confirmed. The results suggest that greater use of active methodologies to promote the development of transversal or generic competences is highly recommended and that the insertion of transversal subjects into university curricula may be highly beneficial.

Keywords COMPETENCES, COMMUNICATION, ACTIVE LEARNING, HIGHER EDUCATION

1 INTRODUCTION

Globalisation, understood as the growing interconnectedness and intercommunication between people and countries across the world, has brought with it numerous social, educational, economic, and technological transformations. The workplace increasingly demands that candidates have a set of generic skills, especially around communication and collaborative working. These skills have become fundamental for any type of employment and for

life in general (Alles, 2017; N. C. García, 2018; González, 2017; Jalinus, Syahril, Nabawi, & Arbi, 2020; Martínez-Clares & González-Lorente, 2019; Owens & Hite, 2022).

In response to these changes, developing higher education programs based on the learning of these essential competences has become a top priority within the EHEA. Competences refer to an integrated set of skills, abilities, attitudes, and values that lead to personal excellence (European Commission, 2018; Crespí & García-Ramos, 2021; Felce et al., 2016).

Fomenting the development and acquisition of these competences requires a change of paradigm in the educational model, changing from traditional methodologies focused on the teacher as the main transmitter of knowledge and content towards active and experiential approaches (Benito & Cruz, 2006). Students become the centre and driver of their own learning, with "a conscious and active involvement in the process" (León et al., 2019, p. 25). This furthers an integral, meaningful and transferable learning experience. With PBL, the role of the teacher is to act as a guide and facilitator of student learning rather than a transmitter of content (Toledo & Sánchez, 2018). There are a number of active learning methodologies, one of which is Project-based Learning or PBL (Gargallo-López, Pérez-Pérez, Verde-Peleato, & García-Félix, 2017; Labrador & Andreu, 2008; Silva & Maturana, 2017; Villa & Poblete, 2011; Villardón-Gallego, 2015).

PBL promotes the active participation of the student (Balsalobre & Herrada, 2018; J. García & Pérez, 2018; Guerrero & Calero, 2013), facilitating, as Fajardo and Gil (2019) affirm, an adequate environment for the development of social competences through teams with diverse profiles to carry out projects and provide solutions to real problems. Generally speaking, PBL in the university environment has been presented as an effective method to develop specific competences; that is, those within a specific area of knowledge (Baş & Beyhab, 2010; Redkar, 2012; Thomas, 2000). However, PBL has also been shown to be an ideal method for the development of generic or transversal competences, common to different fields and necessary for life in general (Alves et al., 2016; Ismail, Aziz, Hong, & Zainal, 2020; Mohedo & Bújez, 2014; Owens & Hite, 2022).

PBL consists in approaching a complex problem or question to which work teams have to respond through the research, design and real application of a proposal (Bender, 2012; Garrigós & Valero-García, 2012; Shadiev, Hwang, & Huang, 2015; Vergara, 2015). The work teams are made up of students with different personalities, aptitudes, competences, interests etc., who collaborate to provide feasible solutions to real problems (Sánchez & Vidal, 2013). Teams are given a long period of time for their projects, during which they have to learn to put into practice some of the specific content of their degree program (specific competences) and a number of personal skills (generic competences), such as teamwork and communication (Imaz, 2015). Planning, organisation and monitoring in the PBL methodology are key aspects in developing communication and collaborative teamwork skills (García-Valcárcel & Basilotta, 2017). Thus, according to Toledo and Sánchez (2018), the teacher plays a key role as a facilitator of learning, both in terms of the team and the project itself. The entire process is evaluated, not merely the tangible results of projects (González-Monteagudo & León-Sánchez, 2020; Imaz, 2015). Evaluations encompass all learning outcomes, including the aims of the project as an intermediate goal, and the development of competences as

the final goal. This 360-degree evaluation, carried out by the teacher, the student and the rest of the team, is highly appropriate to this type of work as it allows for a more complete assessment of learning outcomes (González-Monteagudo & León-Sánchez, 2020).

This teaching methodology first began to be used in early school education, postgraduate studies and professional training (Cascales & Carrillo, 2018; García-Valcárcel & Basilotta, 2017; Gonçalves, 2014; González-Monteagudo & León-Sánchez, 2020).

The use of PBL in undergraduate university programs is more recent and has generally been applied in technical subjects (Bédard, Lison, Dalle, Côté, & Boutin, 2012; Manchado & Berges, 2013; Sánchez & Vidal, 2013; Toledo & Sánchez, 2018). In these experiences, PBL is used as an active learning methodology that primarily favours the development of technical skills and, secondarily, transversal competences (Alves et al., 2016; Mohedo & Bújez, 2014). With regards to the latter, teachers particularly focus on the development of communication skills and teamworking and students themselves have claimed to see their competences in these areas reinforced (Bédard et al., 2012; Pugh & Lozano-Rodríguez, 2019).

A number of studies have shown that PBL is an effective pedagogical tool in the development of communication and teamworking skills, given the dynamism of this methodology (Bohórquez & Checa, 2019; Cruz, Serrano, & Rodríguez, 2021; Fajardo & Gil, 2019; Finocchiaro, 2020; Toledo & Sánchez, 2018). However, existing research has significant shortcomings in both approach and design. Firstly, these studies are presented as isolated from a specific subject or course; that is, they are generally presented as an example of teaching innovation, since PBL is not used as an established methodology in the course itself (Indahwati, Tuasikal, & Ardha, 2019; Leite, 2017; Nainggolan, Hutabarat, Situmorang, & Sitorus, 2020). The result has been that sample sizes are insufficient to be able to draw relevant and representative conclusions. Furthermore, studies often find positive evaluations of PBL by students, as in Toledo and Sánchez (2018), while in some cases findings are based on a narrow evaluation of transversal competences, such as the study by Bohórquez and Checa (2019), using few items for each competence.

Therefore, although these studies are interesting, they are also insufficient and improvable in terms of their design, especially in analysing the real impact of PBL on the development of transversal competences, the key to a comprehensive university education.

The present study offers a satisfactory design in terms of sample size, the use of a control group and a reliable and valid questionnaire on personal skills. It also presents an innovative university experience of PBL, proposing to use this technique in a cross-sectional curricular subject (Interpersonal Skills and Competences-HCP), taught in the first year of all degree programs. HCP mainly develops transversal competences rather than specific skills more typical of technical subjects. The course uses various active methodologies, specifically PBL, as the most appropriate method for the development of interpersonal skills of teamwork (climate management, cooperative work, results orientation), and communication (verbal, non-verbal, for verbal, social communication: assertiveness, empathy, and active listening). These competences may be considered essential in any aspect of life.

1.1 Objectives and Hypotheses of the Research

This research aims to demonstrate the effectiveness of the PBL methodology within the context of a transversal subject in developing interpersonal competences, teamworking and communication skills. The project proposes the following principal hypotheses (H):

1. H1: There are differences in the level of development of interpersonal competences on the whole between students receiving the PBL methodology in transversal subjects (EG) and those who do not (CG).
2. H2: There are differences in the level of development of teamworking competences (climate management, cooperative work and results orientation) between students receiving the PBL methodology in transversal subjects (EG) and those who do not (CG).
3. H3: There are differences in the level of development of interpersonal communication skills (verbal, non-verbal and social communication) between students receiving the PBL methodology in transversal subjects (EG) and those who do not (CG).

2 MATERIALS AND METHODS

2.1 Design of the Research and Sample

This is a quasi-experimental research project with a pre-test-post-test design and a non-equivalent control group. PBL is the pedagogical methodology and constitutes the main independent variable of the study. Additionally, gender and faculty are independent secondary variables, and the interpersonal skills of teamwork and communication are the dependent variables of the study.

The population consisted of all first-year university students in the Community of Madrid. Specifically, two universities participated in this study: the Francisco de Vitoria University, where the experimental group (EG) was enrolled, and the Complutense University of Madrid (Faculty of Education) as a control group (CG). In both cases, the profile of the sample was homogeneous: students 18 years of age in their first year of university with a middle to upper-middle socioeconomic level. Sampling was incidental and unintentional. To calculate the sample size, we started with students enrolled in each university (1,985 students in total) and used the statistical program Jan 3.0 (95% confidence interval, SD = of 3 and accuracy = .4). The result was a total of 444 students, distributed into each stratum; in this case, faculty. Finally, we worked with a sample of 610 students. In this calculation, the loss of participants, which was minimal given the exhaustive review prior to administering the questionnaire to the students, was already discounted. As such, adequate size and representativeness of the sample was ensured (Table 1).

The distribution of the sample by faculty and gender is presented below (Table 2).

2.2 PBL Methodology in Transversal Subjects

PBL is an active teaching-learning methodology within the subject Interpersonal Skills and Competences, the aim of which is to promote the personal and professional development of

Table 1 Sample size in relation to population size

Group	Population size	Minimum sample size	Pre-test sample size	Post-test sample size
Control Group (CG)	670	217	223	193
Experimental Group (EG)	1.315	227	387	354
Total	1.985	444	610	547

Source: The author

Table 2 Sample size by faculty, gender, and university

Faculty	Sample size	Female students	Male students
Education Sciences GE (UFV)	58	46	12
Experimental Sciences GE (UFV)	49	38	11
Communcication Sciences GE (UFV)	72	45	27
Health Sciences GE (UFV)	95	81	14
Legal and Business Sciences GE (UFV)	66	27	39
Advanced Polytechnical School GE (UFV)	47	9	38
Education Sciences GC (UCM)	223	171	52
Total UFV	387	246	141
Total UCM	223	171	52
Total sample	610	417	193

Source: The author

the student through the acquisition and development of transversal competences. Specifically, this subject, among other things, asks the student, as an important part of their evaluation, to carry out a final project in a team with the dual objective of:

1. Developing their transversal competences, especially those of an interpersonal nature i.e. teamwork and communication skills.

2. Implementing a project from the particular field of each degree program to improve and transform society and offer a real response to a social need.

To meet these two objectives, this project constitutes a true example of PBL, scrupulously following each of its phases.

The students, from the first to the last day of class, are organised into teams, created randomly using a specific program. The aim is to simulate a real working world scenario in which they have to work with new, unfamiliar people. Furthermore, the classroom desks are arranged in groups to facilitate the two key competences: communication and teamwork.

To achieve both objectives, the project is structured in the following phases (Figure 1):

1. Phase 1. Analysis, research, and individual and team proposals. In this phase, students must observe reality and detect a need to which they want to respond as a team from their particular field. The research and initial project proposal is, at first, individual. Subsequently, the individual proposals are presented, and the team reaches a consensus on the final definition of the problem and a research project to pursue, and brainstorms possibilities for intervention. It is important to note that, throughout this and successive phases, the teacher oversees not only the results of the project but the

entire development process of each team, facilitating collaborative work. Through a number of experiential classes, the foundations for a real work team are created, thus developing the skills associated with communication and teamwork. In this phase, students develop their notions of identity, collaborative roles, and forms of decision-making within a team.

2. Phase 2. Design and development of the project. In this phase the teams, using tools such as mind maps and empathy maps, develop and define their proposal. Teams then proceed to conceptualise the idea/solution. The teacher works with the teams on competences related to teamwork and communication: organisation and planning of the project (scheduling), work phases, assertiveness, empathy, and active listening.

3. Phase 3. Application. In this phase, the teams put their ideas into practice over a period of approximately 8 weeks. Students develop their competences in areas such as managing a team, team building and conflict resolution.

4. Phase 4. Submission of the final report. This is a reflective compilation of the project, divided into two parts: 1) Part one refers to learning and demonstration of transversal competences. These are the results of their experience as a team and the experiential classes which address critical components of the interpersonal competences. 2) Part two refers to the results of the project. The report rigorously outlines the research and approach to the problem, the design and execution of the project and the results achieved. In this phase, the teacher works with the teams to improve their written and oral communication skills. These include techniques to organise and write the report to be presented, with structure and academic rigor. The students develop their speaking and oral expression skills, with simulation exercises such as the *elevator pitch*, and learn to properly prepare a formal oral presentation.

5. Phase 5. Presentation of the project before a jury. In this phase, the teams present their project with specific emphasis on the results in addressing the issue identified; secondly, students demonstrate their acquired skills and competences. The jury consists of teachers on the course and the degree program. They evaluate the team projects using an established evaluation rubric. This work accounts for 35% of the grade for the course.

2.3 Procedure for Data Collection and Analysis

Two universities participated in the study. The same pre-test (start of the course) and post-test (end of the course) procedures and guidelines were followed for both the EG and the GC. In both cases, the questionnaires were administered, supervised, and collected by the same person. Descriptive (mean, standard deviation, variance, and range) and correlational (Pearson correlation coefficient) analyses were carried out. The hypotheses were also contrasted by means of an ANOVA F, effect size and *post hoc* tests (Scheffé).
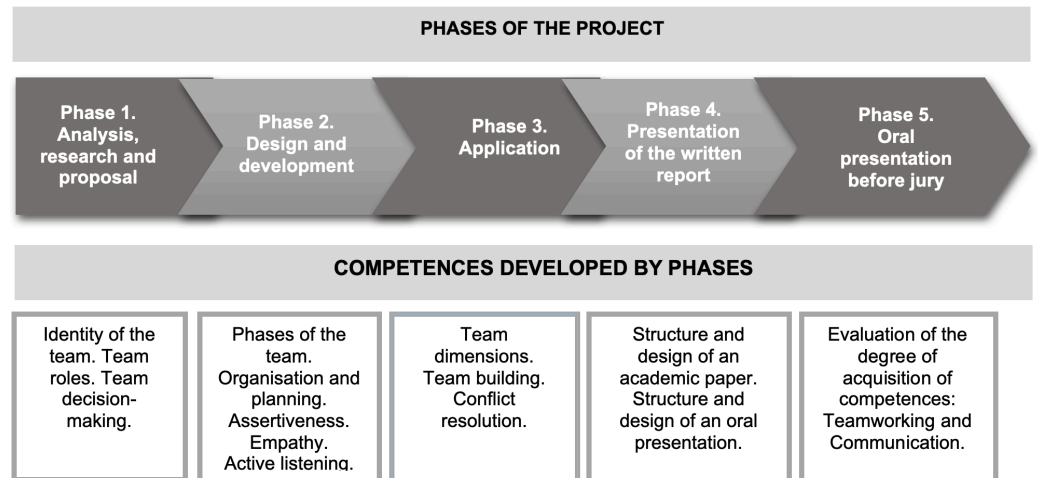
Figure 1 Phases and interpersonal transversal competences associated with PBL

2.4 Measurement Instrument

The Questionnaire on Transversal Personal Competences - QTPC (Crespí & García-Ramos, 2021) was used to measure the level of acquisition of interpersonal skills.

The questionnaire consisted of 37 items with a Likert-type scale from 1 to 6 (Crespí, 2019). The first 18 items corresponded to intrapersonal competences and were grouped into two dimensions: knowledge and self-improvement. The remaining 18 items corresponded to interpersonal competences and were grouped into two other dimensions: teamwork and communication. Item 37 was a criterion item; that is, an item designed to assess the global level of competence. Specifically for this research, the part of the questionnaire referring to teamwork and communication skills (18 items) was used.

To analyse the results of the questionnaire, a reliability test (Cronbach's Alpha), homogeneity of items (HI), validity of items (IV) and convergent validity analysis of the whole instrument (Pearson correlation coefficient) were carried out. An exploratory factor analysis was also performed (factorisation and rotation methods: ACP, MV, Promax and Oblimin) and a confirmatory factor analysis, with structural equations and the usual goodness of fit statistics, which gave consistency to the construct.

The reliability and criterial validity tests of the QTPC (Table 3), show excellent overall internal consistency (.94) as well as their interpersonal and intrapersonal competences (.90 in both cases) and an acceptable degree of validity (.69) for the global questionnaire and acceptable (=>.64) degree of competences, with significant linear correlations.

The homogeneity and validity of items was higher than .20, in all cases, indicating satisfactory values. Finally, both exploratory and confirmatory factor analyses confirm the acceptable dimensional structure of the questionnaire.

Table 3 Analysis of the reliability and validity of the instrument

	Reliability (Cronbach's alfa)	Validity (Pearson correlation coefficient)	Nº ítems
Global questionnaire	.94	.69	36
Global intrapersonal competences	.90	.64	18
Deep looking competence	.83	.60	9
Personal growth competence	.83	.59	9
Global interpersonal competences	.90	.65	18
Teamworking competence	.83	.54	9
Communication competence	.86	.63	9

Source: The author

3 RESULTS

3.1 Descriptive Analysis

The descriptive analyses of the different dependent variables (global interpersonal competence, competences of teamwork: cooperative work, results orientation, climate management; and communication competences: verbal, non-verbal and social) indicate that mean post-test results are higher than pre-test results for both the EG and the GC (prior to the contrast of hypotheses). However, the mean difference is notably greater in the EG than in the GC.

3.2 Inferential Analysis

3.2.1 Initial Analysis

Before contrasting the main hypotheses of the research, various analyses were carried out. In this way, we observe the evolution of each group (EG and CG) in terms of the development of different interpersonal skills, comparing pre-test and post-test results.

First, we will analyse the evolution of the EG (Table 4).

Table 4 Pre-test / Post-test differences in the EG

Interpersonal Competences	Mean Pre-test GE	Mean Post-test GE	Mean differences Post-test / Pret-test	F	Sig.	ES (η^2 partial)
Global interpersonal competences	74.64	90.66	16.02	413.01	.00	.36
Team working	38.84	45.74	6.90	260.30	.00	.26
Cooperative work	13.25	15.76	2.51	203.89	.00	.22
Climate management	13.33	15.44	2.11	175.00	.00	.19
Results-oriented	12.26	14.53	2.27	178.39	.00	.19
Communication	35.79	44.92	9.13	436.03	.00	.37
Verbal communication	12.25	15.29	3.04	335.78	.00	.31
Non-verbal communication	10.65	14.38	3.73	318.28	.00	.30
Social communication	12.89	15.25	2.36	209.22	.00	.22

Source: The author

Significant improvements in post-test results are observed for all competences and the effect size is large in all cases. This implies, firstly, that EG students made significant progress in the development of interpersonal competences as a whole; and in particular, of team-working (cooperative work, results orientation, climate management) and communication skills (verbal, non-verbal and social communication). This points to the success of the use of PBL methodologies in transversal subjects; in all cases a very large effect size is observed, ranging from .37 to .19.

Second, we will analyse the evolution of the GC (Table 5).

Table 5 Pre-test / Post-test differences in the CG

Interpersonal Competences	Mean Pre-test GC	Mean Post-test GC	Mean differences Post-test / Pre-test	F	Sig.	ES (η^2 partial)
Global interpersonal competences	78.70	82.58	3.88	13.82	.00	.03
Team working	41.01	42.89	1.88	10.86	.00	.03
Cooperative work	14.00	14.82	.82	11.80	.00	.03
Climate management	14.12	14.52	.40	3.32	.07	-
Results-oriented	12.89	13.54	.65	8.53	.00	.02
Communication	37.69	39.69	2.00	11.62	.00	.03
Verbal communication	13.15	13.55	.40	3.32	.07	-
Non-verbal communication	11.04	12.12	1.08	13.63	.00	.03
Social communication	13.50	14.02	.52	4.97	.03	.01

Source: The author

In the case of the GC, there was no significant progress in the development of all competences. The competences of climate management and verbal communication show no significant differences, while in the rest of the competences, where significant differences are observed, the effect size is weak (between .01 and .03), implying that these differences are of lesser relevance.

Third, the existence of any significant pre-test differences between the EG and the GC (Table 6) was evaluated.

A difference is observed in favour of the GC in all cases. This indicates that the initial self-perception of the GC students was higher than those of the EG. This is confirmed by the F statistic which shows significant differences in favour of the GC for all competences except for non-verbal communication. However, it should be noted that these differences are not very relevant, having a weak effect size (η^2 = < .03).

3.2.2 Contrast of Principal Hypotheses

The contrast of main hypotheses (H) shows that:

H1: There are differences in the degree of development of interpersonal competence on the whole between students who receive PBL in the context of a transversal subject (EG) and those who do not (GC) (Table 7).

A mean difference of 8.08 points is observed in favour of the EG, a sizable difference with a significant effect size (η^2 = .14). This indicates that the EG developed greater interpersonal

Table 6 Pre-test differences between the EG and CG

Interpersonal Competences	Mean GE	Mean GC	Mean differences GE-GC	F	Sig.	ES (η^2 partial)
Global interpersonal competences	74.64	78.70	-4.06	17.05	.00	.03
Team working	38.84	41.01	-2.16	16.17	.00	.03
Cooperative work	13.25	14.00	-.75	11.07	.00	.02
Climate management	13.33	14.12	-.79	14.91	.00	.02
Results-oriented	12.26	12.89	-.63	9.21	.00	.02
Communication	35.79	37.69	-1.90	12.78	.00	.02
Verbal communication	12.25	13.15	-.90	18.39	.00	.03
Non-verbal communication	10.65	11.04	-.39	2.46	.12	-
Social communication	12.89	13.50	-.61	8.98	.00	.02

Source: The author

Table 7 Differences in the development of interpersonal competences between the EG and CG

Interpersonal Competences	Mean GE	Mean GC	Mean differences GE-GC	F	Sig.	ES (η^2 partial)
Global interpersonal competences	90.66	82.58	8.08	91.43	.00	.14

Source: The author

competence on the whole than the GC. This difference is due to participation in PBL in the context of a transversal subject.

H2: There are differences in the degree of development of teamwork skills (climate management, cooperative work, and results orientation) between students who receive PBL in the context of a transversal subject (EG) and those who do not (CG) (Table 8).

Table 8 Differences in the development of teamworking competences between the EG and CG

Interpersonal Competences	Mean GE	Mean GC	Mean differences GE-GC	F	Sig.	ES (η^2 partial)
Team working	45.74	42.89	2.85	39.38	.00	.07
Cooperative work	15.76	14.82	.94	25.75	.00	.05
Climate management	15.44	14.52	.92	28.04	.00	.05
Results-oriented	14.53	13.54	.99	27.92	.00	.05

Source: The author

A mean difference is observed for teamwork of 2.85 points in favour of the EG. This is a significant difference, with a moderate effect size ($\eta^2 = .07$). Thus, the EG developed greater teamworking competence than the GC, largely due to participation in PBL in the context of a transversal subject.

Looking more specifically at the skills associated with teamwork, it can be observed that in all three cases: cooperative work, climate management, and results orientation, the mean differences in favour of the EG (between .92 and .99) are in all cases significant, with a moderate effect size ($\eta^2 = .05$). This indicates that the differences in these competences are partly due to participation in the PBL in the context of a transversal subject.

H3: There are differences in the degree of development of interpersonal communication skills (verbal, non-verbal and social communication) among students who receive PBL in the context of a transversal subject (EG) and those who do not (CG).

Table 9 Differences in the development of communication competences between the EG and CG

Interpersonal Competences	Mean GE	Mean GC	Mean differences GE-GC	F	Sig.	ES (η^2 partial)
Communication	44.92	39.69	5.23	111.50	.00	.17
Verbal communication	15.29	13.55	1.74	95.96	.00	.15
Non-verbal communication	14.38	12.12	2.26	81.68	.00	.13
Social communication	15.25	14.02	1.23	44.22	.00	.08

Source: The author

The mean difference in communication competences overall is 5.23 points in favour of the EG. This is a sizable difference with a significant effect size ($\eta^2 = .17$). Thus, the EG developed communication competence at a higher level than the GC due to participation in PBL in the context of a transversal subject.

Looking more specifically at the competences associated with communication, the results show that in all three cases: verbal communication, non-verbal communication, and social communication, the mean differences in favour of the EG (values between 1.23 and 2.26) are significant in all cases with an effect size between moderate and high (η^2 between .08 and .15). It can therefore be said that these differences are largely due to participation in PBL in the context of a transversal subject.

It appears that PBL, in the context of a transversal subject, has a greater impact on the development of communication competences ($\eta^2 = .17$) than on team competences ($\eta^2 = .07$).

Finally, and although not the main focus of this research, we wanted to contrast whether PBL showed greater impact on any specific faculty or gender. Given the non-existence of any significant differences in pre-test scores by faculty (Education, Communication, Health, Experimental Sciences, Polytechnical school, Business and Law) and gender (men and women) with respect to interpersonal competences, the post-test results show:

1) The existence of mean differences between faculties. Specifically, significant differences were only observed in global interpersonal competence, teamwork competence, climate management, results orientation and non-verbal communication, although the effect size is weak. Finally, the *post hoc* test (Scheffé) shows differences between the faculty of education, the polytechnical school and the faculty of health sciences; always in favour of the former (Table 10).

2) Mean differences in favour of female students in all cases, with significant differences observed in all competences except in non-verbal communication. However, the effect size

Table 10 Differences between students participating in PBL by faculty

Interpersonal Competences	F	Sig.	ES (η^2 parcial)
Global interpersonal competences	2.91	.01	.04
Team working	3.53	.00	.05
Cooperative work	1.62	.15	-
Climate management	3.50	.00	.05
Results-oriented	3.31	.01	.05
Communication	1.98	.08	-
Verbal communication	1.12	.35	-
Non-verbal communication	3.33	.01	.05
Social communication	1.25	.29	-

Source: The author

is from moderate to weak (Table 11).

Table 11 Differences between students participating in PBL by gender

Interpersonal Competences	Average Women	Average Men	Mean Differences	F	Sig.	ES (η^2 partial)
Global interpersonal competences	92.14	87.29	4.85	23.55	.00	.06
Team working	46.62	43.74	2.88	29.73	.00	.08
Cooperative work	16.02	15.17	.85	15.87	.00	.04
Climate management	15.67	14.94	.73	13.45	.00	.04
Results-oriented	14.93	13.64	1.29	32.04	.00	.08
Communication	45.52	43.55	1.97	10.88	.00	.03
Verbal communication	15.46	14.89	.57	7.06	.01	.02
Non-verbal communication	14.49	14.12	.37	1.49	.22	-
Social communication	15.57	14.54	1.03	23.66	.00	.06

Source: The author

4 DISCUSSION AND CONCLUSION

One of the greatest challenges for universities is to provide a comprehensive education in which the student is an active agent in their own learning. To this end, experiential classes are being introduced that promote more meaningful and transferable learning (Benito & Cruz, 2006; European Commission, 2018; García, 2018; Gargallo-López et al., 2017; Gijón, 2016; Labrador & Andreu, 2008; Martínez et al., 2019). The development of competences is also being promoted through the progressive incorporation of active learning methodologies such as PBL (Bédard et al., 2012; Manchado & Berges, 2013; Sánchez & Vidal, 2013; Toledo & Sánchez, 2018).

PBL is a collaborative learning methodology that is highly appropriate to the development of competences, transversal and specific, in which students not only grow intellectually, but also personally. Students learn to learn. According to Fajardo and Gil they also learn "to value themselves, to value others and to see beyond the standardised" (2019, p. 105).

An in-depth review of existing literature revealed several studies that present the PBL methodology as a key element in the development of technical competences (Cruz et al., 2021; Manchado & Berges, 2013), as well as the transversal skills (Estepa & Estepa, 2011; Sánchez & Vidal, 2013; Toledo & Sánchez, 2018) of teamwork and communication (Alves et al., 2016; Bédard et al., 2012; Jalinus et al., 2020; Mohedo & Bújez, 2014; Pugh & Lozano-Rodríguez, 2019).

This research, in general, confirms the results of previous research, specifically with regards to the contribution of PBL as an ideal technique for the development of the transversal skills of teamwork and communication. However, unlike previous research, the present study offers a better research design and more conclusive results.

Firstly, the findings show a very different evolution of the EG (receiving PBL) and the CG (not receiving PBL). The EG (Table 4) significantly developed their interpersonal skills generally, and specifically teamwork (cooperative work, climate management and results orientation) and communication (verbal communication, non-verbal communication, and social communication), as a result of PBL in the context of a transversal subject in all cases (η^2 large). However, the GC (Table 5) did not significantly improve their interpersonal competencies (climate management and verbal communication), and in the case of significant differences, these were not relevant (η^2 small). Thus, the positive effect of PBL on the development of interpersonal teamwork and communication skills is indeed confirmed (Bohórquez & Checa, 2019; Cita, Sierra-López, Ordóñez-Ordónez, & Cepeda-Valencia, 2020; de los Ríos, Cazorla, Díaz-Puente, & Yagüe, 2010; Fajardo & Gil, 2019; Finocchiaro, 2020; Ismail et al., 2020; Jalinus et al., 2020; Owens & Hite, 2022; Toledo & Sánchez, 2018). Furthermore, it seems logical that the GC made little progress in the development of these competences since, although working in groups, the methodology used had less impact on the development of these competences than PBL (Baghcheghi, Koohestani, & Rezaei, 2011; Saenab et al., 2018; Walker & Slotterbeck, 2002).

Secondly, the results of Hypothesis 1 (Table 7), indicate significant differences in the development of interpersonal competences on the whole between the EG and the CG, in favour of the former. These differences are due to the use of PBL in the context of a transversal course (η^2 large). The results of Hypotheses 2 and 3 (Table 8; Table 9) show significant differences in the development of competencies associated with teamwork (cooperative work, climate management and results orientation) and communication (verbal communication, non-verbal communication, and social communication), in favour of the EG. These differences are also due to PBL in a transversal subject (η^2 significant for communication in general and medium for the teamwork competence as a whole). Therefore, the impact of PBL on the development of interpersonal competences is evident in all cases. Significantly, this is despite the fact that the starting point or self-perception of interpersonal competences on the part of the EG was somewhat lower, in general terms, than that of the GC (Table 6).

Finally, it seems that PBL, in the context of a transversal subject, has a greater impact on the development of communication competences (η^2 = .17) than on team competences (η^2 = .07). This is because, as mentioned, technical subjects generally (as in the case of the GC) use different active methodologies, such as group work, which encourage the devel-

opment of teamworking skills (García-Valcárcel & Basilotta, 2017; Gijón, 2016; Guerrero & Calero, 2013; Imaz, 2015; Jauregui, 2018; Manchado & Berges, 2013; Toledo & Sánchez, 2018; Villardón-Gallego, 2015). It is therefore logical to find PBL has a lesser impact on teamwork. However, precisely because the development of teamworking skills is not a high priority within the curriculum, does not apply PBL, and lacks teacher's expertise in the development of this competence, the results of the CG compared to the EG are still significantly lower. This may be due to the fact that technical subjects focus on a limited number of specific competences (Pugh & Lozano-Rodríguez, 2019) and, therefore, technical subjects address these specific competences as a priority. The teachers of technical subjects, although they have acquired certain skills in teaching with various active methodologies, are not specialists in the content or development of transversal competences (Nainggolan et al., 2020; Redkar, 2012). The same is also the case with transversal subjects but in the opposite direction; these subjects aim to develop generic competences with more specific competences being secondary.

In any case, although the results of this project are in line with those of previous research on the impact of PBL on the development of the transversal skills of teamwork and communication, the importance of the present research to the educational community is significant since, unlike previous studies, this is based on solid research: 1) with quasi-experimental pre-test / post-test design, 2) with an experimental group and a control group, 3) with a large and representative sample size and 4) with the application of a reliable and valid questionnaire to measure interpersonal skills such as teamwork and communication. In addition, the present study has an innovative design, given that PBL is applied as a technique for the development of teamwork and communication skills though a compulsory transversal subject, with teachers who are experts in the development of these skills.

As noted above, generally speaking, research in this field has largely regarded PBL in terms of an innovative methodology applied to technical subjects, aiming to develop a series of specifically technical skills and competences with transversal competences of communication skills and teamworking being secondary or complementary (Estepa & Estepa, 2011; Sánchez & Vidal, 2013; Toledo & Sánchez, 2018). However, given the fact that these studies are of specific cases of educational experience: 1) they do not have a sufficiently large sample and so do not represent the target population; 2) they do not use a control group and so cannot make comparisons between groups; 3) they do not have a pre-test / post-test design and so cannot effectively analyse what students have learned; and 4) they do not use a reliable, validated questionnaire and open-ended questions or rubrics are generally used to observe progress in these competences. Thus, there is a lack of rigorous scientific studies that can statistically support these initial findings.

Finally, this research aims to highlight the importance of transversal subjects in university curricula. While technical subjects occasionally use cooperative learning methodologies such as PBL, methodologies that, by their nature, encourage the development of interpersonal communication and teamwork skills (Fini, Awadallah, Parast, & Abu-Lebdeh, 2018; Walker & Slotterbeck, 2002), the development of these competences is more significant within transversal subjects; that is, subjects whose main objective is the development

of generic competences and with teachers specialised in their development. The constant effort of expert teachers in student accompaniment, and individual and team follow-up, are critical factors in the use of active methodologies such as PBL (García-Valcárcel & Basilotta, 2017; Gargallo-López et al., 2017; Silva & Maturana, 2017).

In conclusion, this research has proposed an innovative model of PBL within the context of a transversal curricular subject, and focused on the development of transversal competences, especially those of teamwork and communication. In addition, it has been possible to demonstrate the effectiveness of PBL in the development of these skills among university students receiving this course. Thus, the results of this research seem relevant, considering that our increasingly global environments of higher education and work recognise the need for students to demonstrate an adequate level of basic transversal competences, putting them on a path to personal and professional growth (Alles, 2017; Martínez et al., 2019; Martínez-Clares & González-Lorente, 2019; Pugh & Lozano-Rodríguez, 2019).

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