Article

University Social Responsibility towards Engineering Undergraduates: The Effect of Methodology on a Service-Learning Experience

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Abstract: Service-Learning (SL) experiences enable University Social Responsibility (USR) to be worked on in engineering studies as a core of education for Sustainability. The combined use of such experiences with active student-centered teaching methodologies fosters the acquisition of general and specific competences. On the basis of students' perception, this study investigated and sought evidence of empirical foundations to understand whether and how Project Based Learning (PBL) affects the acquisition of USR-related competences when SL experience was implemented as the regular exercise in core courses in engineering studies. This research studied 100 second year undergraduate students in Industrial Design Engineering and Product Development. The students were divided into two groups, one of which experienced Service-Learning only in one class activity while the other group carried out a PBL activity. A survey consisting of 28 items was delivered to all these students and their answers were analyzed from a descriptive statistics viewpoint to understand how the students perceived their degree of attainment of USR competences. The findings suggest a clear difference between the methodologies used, which shows that PBL methodology may lead to a greater acquisition of USR competences than SL activity.

Keywords: Service-Learning; Project Based Learning; University Social Responsibility; materials science and engineering; higher education

1. Introduction

The changes that have taken place in society over the past few decades require universities to reconsider their role in it. In this sense, the traditional role of universities as centers for the creation and transmission of knowledge has become obsolete. Their place in the society of the 21st century has yet to be refined, if not defined [1–5]. Kliksberg [3] states that "the university of the 21st century, the century of great technological opportunities, but at the same time of unacceptable social poverty and suffering, must reform itself technologically to become the basis for progress, but above all it must renovate its social responsibilities in order to be more than ever a reference in the construction of peace and justice for ordinary people". Focusing on the formative facet, Kliksberg indicates that "The university should prepare economists, administrators, doctors, lawyers, engineers and specialists in all fields, with a solid grounding in responsibility so that they can make decisions on the ethical

dilemmas that they face with fundamental moral values and undertake service commitments to the weakest". Furthermore, Gasco-Pliego et al. demand professionals with a sense of social responsibility that questions economic rationality, competition without limit, and exacerbated self-interest, instead of promoting values such as solidarity, cooperation, equality, and mutual respect [6].

Similarly, regarding the functions of universities, Martínez [7] postulates that they should be more than centers for preparing qualified professionals and generating knowledge and should become places for the transformation of people and society, enabling young people to acquire the competences that citizens need to live sustainably, at personal, professional, and community levels. Accordingly, concepts such as sustainability, equality, inclusion, gender, and responsibility no longer belong exclusively to the personal sphere but also fall within the formative facet of the social impact of universities, as proposed by Vallaeys in his definition of University Social Responsibility (hereinafter USR) [8]. It is therefore desirable for higher education to include competences associated with the scope of USR. Moreover, in present time, USR competences must also be demandable in any occupational field and the daily work in universities as an example of dissemination of best practices; thus, citizen responsibility, sustainable development, and social commitment and action are already considered as values associated with job performance, and therefore linked to the competencies of specialists, which is the focus of training and education process in higher education [4,8–11].

The introduction of the USR competences into the education of undergraduates requires the general presence of key educational elements, such as defining specific learning objectives, using instructional methods that address these competences, implementing active pedagogies such as PBL or collaborative learning to job-related scenarios that requires a decision with ethical implications, for which the student will be able to identify possible courses of action, discuss the pros and cons of each one, make decisions, and justify their decisions [12,13]. Certain studies associated with occupations have found that the acquisition of competences associated with USR was spontaneous when it came to disadvantaged individuals and groups. Historically, however, social responsibility has not been taken into account in the design of degree courses or included in the learning outcomes of curricula [14]. Recently, The International Quality Certification Agencies for Engineering Studies in both Europe (ENAEE, European Network for Accreditation of Engineering Education) [15] and the USA (ABET, Accreditation Board for Engineering and Technology) [16] have incorporated a facet of social responsibility into the learning outcomes of engineering studies.

Under the ENAEE's Standards and Guidelines for Accreditation of Engineering Programmes (EAFSG), to obtain the EUR-ACE® label, social awareness must be included within its program outcomes for both undergraduate and master's degrees. For the former, it requires engineers to have the "ability to gather and interpret relevant data and handle complexity within their field of study, to inform judgments that include reflection on relevant social and ethical issues". Similarly, master's degrees graduates must possess the "ability to integrate knowledge and handle complexity, to formulate judgments with incomplete or limited information that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgment". For its part, ABET specifies in Criterion 3C "an ability to design a system, component, or process to meet desires within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability" as one of its learning outcomes.

Accordingly, Kilkserg [4] points out that USR competencies "requires working not only with texts, but with concrete experiences and active contact with reality. The ideal is not to offer an ethics course in the curriculum, but to mainstream the teaching of applied ethics, working on the ethical problems particular to each area, and in all areas on commitment to the construction of a world of solidarity". According to Kolmos et al. [17], the required changes to adapt engineering studies to these new circumstances were complex, since engineering studies maintain a traditional culture where the introduction of methodological changes is not spontaneously accepted by some teachers. In this regard, engineering studies still maintain traditional talks-based classes as their predominant methodology, so delivery and assessment based on competences is still far from being

widespread [18]. Moreover, the introduction of new methodologies and competencies can be perceived by some teachers and students as a distraction or as an element that distorts the ability to assess the knowledge acquired [1,19,20]. Therefore, work on skills of this type in engineering studies poses a greater challenge to teachers, if such a thing is possible [18,21]. At the same time, integrating these competencies into the curriculum is no trivial matter. The increasing research on defining URS competences and on the connection between pedagogical approaches and how they may affect their achievement has been recently reviewed by Lozano et al. [22]. As with other authors [23,24], we consider it essential to address efforts to set out educational proposals that promote the new competences of USR while enabling them to be integrated in a real, effective fashion into the education system and into the current reality at universities.

One of the methodological tools that are currently being used to integrate USR competencies into engineering teaching is Service-Learning (SL). This methodology is yielding very promising results in engineering studies [25]. SL is an experience-based learning method that responds to social demand. With this method, learning takes place through a cycle of action and reflection through which students work with other colleagues by applying what they have learned to the problems of the community, while reflecting on the experience of pursuing real goals for the community and increasing their own understanding and skills; i.e., the students develop multiple human dimensions in a connected way that cultivates civic and social responsibility [1,26].

The accommodation of SL to the field of engineering is due to the fact that it can be applied to common engineering problems relatively easily, which enables it to be integrated into courses and curricula [27]. Thus, if the particular service is directly related to the content of the course or courses, it not only enables the academic content of the course to be covered, but also provides a framework in which students can learn about complex social problems while reflecting on their role as engineers in solving them [28]. It has also been reported that Service-Learning can enhance classroom learning [26] and is consistent with theories for increasing student retention [29]. On the other hand, it has been found that introduction of SL experiences can increase teachers' positive perception towards methodological changes [30], and help students improve their academic performance, motivation, ability to work with others, leadership, aspiration for advanced degrees, and overall satisfaction [31–34].

In a previous study, we found that Project Based Learning (PBL) was a particularly successful methodology in teaching core courses [35], which enables us to work effectively not only on specific competences but also on the so-called generic or transversal ones with good acceptance by all the agents involved [36]. The integration of PBL into SL experiences (PBSL) has proven to be effective for working with specific competences and occupational competences together, and for preparing students for their future careers [1,37,38]. According to Huff et al. [38], a high level of involvement and dedication of students to the SL project that occurs in PBSL create a strong link between these activities and the complexity of the occupational environment. The same conclusion was made by Heinricher et al. [39] and Vaz et al. [40] for engineering studies. Other works [41–43] highlight particular difficulties in implementing activities and methodologies that ensure the outcomes related to sustainability and their efficient assessment. Similarly, the present paper sought to provide empirical foundations, based on the perception of the students, for determining whether and how PBSL positively affects the acquisition of USR-related competences with respect to an SL experience in engineering core courses.

SL experiences have proven to be an excellent vector for working on and assessing both specific and generic skills including USR competences, which are difficult to approach through other types of teaching experiences [25,27,31]. On the other hand, it is accepted that the teaching methodology strongly influences the degree of acquisition of competences and their retention over time. Thus, active methodologies such as PBL make for greater intensity in working on both specific and generic competences, so that the teaching-learning process is more effective [36,39,44]. This could also be extrapolated to competences associated with sustainability and social responsibility and, as those competences are difficult to enunciate and evaluate [41–43], we propose to explore the degree of

achievement by means of the analysis of the students' perception. To the best of our knowledge, there are no studies in the scientific literature analysing these differences based on that information.

In the present study, the same SL experience was carried out in two undergraduate courses but with two different groups of students: the first group took the course, and therefore underwent the experience, using a PBL methodology, making it a PBSL experience. For the other group the SL experience was confined to a single activity in just one course and the rest was addressed through a more traditional methodology with tasks and exercises. According to the classification stated by Lozano et al. [22], the competences we assessed belonged to the groups "Justice, responsibility, and ethics" and "Empathy and change of perspective". SL, a pedagogy integrated in the class "community and social justice", was selected for this work to be used in combination with PBL, a valuable opportunity for the students to work on a real-world problem. The effect of the methodology was analysed by comparing the responses to a survey designed specifically to assess USR competences. The objective was to determine whether there are differences on the perception of the students in the degree of USR acquisition depending on the methodology used.

The work is structured in the following sections. We begin with the description of the sample of students who participated in this work and its context in the engineering studies, followed by the description of the SL experience carried out and the survey used to assess the URS competences. Next, we describe, comment, and discuss the results obtained. Finally, we conclude with the most relevant conclusions of the work. The entire questionnaire is provided in the annexe of this paper.

2. Materials and Methods

The method used in this study is descriptive: data on different aspects, dimensions, or components of the phenomenon to be investigated were measured, assessed, and collected [45].

2.1. Sample and Context

The present study was set in the context of academic year 2015/16 and covered two courses on Year Two of the degree in Industrial Design Engineering and Product Development. The courses involved were Conceptual Design, during the fall semester, and Materials II, during the spring semester. A total of 100 students enrolled in both courses participated. All 100 students underwent the proposed SL experience in the course Conceptual Design. The experience consisted of designing an adapter for cutlery handles that could help people with serious mobility limitations to eat more autonomously. In the Conceptual Design course, the problem set in the SL experience had to be analysed and all the students—in groups—were asked to propose solutions. This assignment accounted for 20% of the assessment of the course. Once the course was completed, the opportunity to voluntarily extend the work on the course Materials II in the second semester was offered. Those who wanted to continue the SL experience had to submit a letter of interest in the project. The students finally selected to participate were chosen on the basis of two criteria: their academic records and their motivations as expressed in a letter. From the 27 letters submitted, 9 students were finally selected to take the course Materials II using a PBSL methodology. Therefore, the sample for this work consisted of two groups of students; on the one hand the group of 91 students (hereinafter G-SL) who underwent an SL experience only in the course Conceptual Design as one more of the assignments of the course and the course Materials II following the traditional methodology based on lectures, laboratory sessions, problem-solving seminars, and monographic tasks. On the other hand, the group formed by the 9 volunteer students, that after studying Conceptual Design in the same way as the rest of their classmates, they took the course Materials II in a different way: 50% of the course was covered using a PBSL methodology and the other 50% was via activities similar to those of the students in the G-SL group. As far as the PBL part of the course was concerned, the project was to continue the process of designing their product up to the prototype phase. We call this latter group G-PBSL. Features of both groups are summarized in Table 1.

Table 1. Summary of the features of the two groups of students participating in the SL experience.

Group Name	No Students	Conceptual Design	Materials II
G-SL	91	SL (assignment)	——
G-PBSL	9	SL (assignment)	SL (PBL)

2.2. The SL Experience

The SL experience was promoted by Maset de Frater, a private centre for people with high levels of disability and very low mobility. Maset de Frater is a very active organization that cares for and seeks to raise the profile of the problems of these people and their integration into society, to which end they organize educational workshops, plays, sports competitions, etc.

The preparation of the activity began with contact between the promoter and the three teachers at the Universitat Jaume I in order to set up the experience. The promoter suggested a number of ideas and proposals that might be useful to users. The teachers met to discuss which of the proposals was most appropriate for them to cover the objectives of their respective courses, i.e., their selection was based on technical and formative criteria. After selecting which product to work with, the schedule, methodology, and tasks to be carried out on both courses were designed, along with the monitoring procedure and tools for coordination between the teachers.

On the Conceptual Design course, students were presented with the SL activity and the possibility of continuing to develop the idea in Materials II in a PBSL activity. The promoter came to the university with the product users and presented to the students the idea of the product that formed the subject of the project. The students who expected to continue with the PBSL in the second semester had the opportunity to visit the promoter to meet the users, so that they could analyse the conditions of use of the product on site.

On the Conceptual Design course, students in the G-SL and G-PBSL groups carried out a market study and worked on the concept of the product. This activity and indeed the semester concluded with the presentation of panels with the most promising conceptual proposals.

In week 1 of the second semester, the students in G-PBSL group prepared a deliverable 0 (D0) containing the idea of the project and a proposal with the four most promising options developed up to their preliminary level (mechanism, component parts, and characteristics of each). The project work was structured in three deliverables that had to be presented in the course of the semester. A schedule was also drawn up and the date for project completion was agreed. At the end of the semester, the students belonging to the G-PBSL group presented the results to the promoter.

2.3. The Survey

The tool used to qualitatively assess the competences associated with USR was the survey. Survey research has been used as an instrument to obtain information from individuals and groups for decades [46]. As Dillman et al. state [47], survey research has aided both students and professionals in effectively gathering data by different means (mail, telephone, internet . . .) and nowadays has become one of the most useful tools for this purpose in different fields [48]. For this work we used an adapted version of the survey by Folgueiras et al. [49]. The questions in the survey are listed in Table A1 (see Appendix A). The questioning was conducted during the last week of the semester once the students had completed their project or the regular assignments of the course Materials II. Before starting to complete the survey, students had to choose if they had taken the course Materials II following PBL methodology or not, i.e., if they belong to the group G-SL or group G-PBSL. Questions 10 and 11 were worded differently for the students in the G-SL and G-PBSL groups for the sake of clarity. The survey was conducted anonymously using Google Forms.

The survey included 28 items divided in four modules. The first module contains two basic questions to describe the demography of the sample; the second module comprises seven questions intended to promote the reflection of the students; the fifteen questions of the third module explore

and measure the impact of the experience on some of the aspects regarding USR dealt through the SL experience; finally, the last module offers the students four open questions to make their own contributions for improving future SL experiences.

3. Results and Discussion

The analysis of the results of the assessment of specific and generic competences is not the purpose of this paper. However, as an aid to interpreting the results of the assessment of USR competences it should be noted that students in the G-PBSL group obtained better final grades in the set of competences for the second semester course (Materials II). Thus, in the case of specific competences (assessed through an examination that was the same for both groups of students), students belonging to the G-PBSL group are observed to score 22% more than those in the G-SL group. Overall, encompassing both specific and generic soft skills, the scores of the students from the G-PBSL group were 40% higher than those from the G-SL group. These differences were irrelevant in the course Design Conceptual. This shows that the PBSL was not only more effective in terms of transversal competences, as might be expected from an active learning methodology, but also could reinforce the acquisition of specific competences. We have already reported these results for the case of students working with the PBL methodology (applied to a project not involving SL) versus students studying the course with a conventional methodology [50].

Student participation in anonymous surveys was 51% for the G-SL group and 78% for the G-PBSL group. The level of responses therefore exceeds 50% in both cases, but greater participation is observed for the students involved in SL for the two semesters.

Regarding the demographic characteristics of the sample (items 1 and 2), the mean ages were similar for both groups (20 years for the G-PBSL and 21 years for the G-SL). There was higher proportion of women responding in the G-PBSL group (69%) compared to G-SL group (50%). The distribution by gender in the original group (with 100 students) enrolled in both courses was 55% male and 45% female which is significantly higher than average enrolment in engineering degrees [51]. The gender distribution in the 27 applications for voluntarily participation in the course Materials II was 66% female and 33% male. This increase in presence of women can be interpreted in the sense that SL experiences are more attractive to them. The final selection of nine students based on marks and interest letter resulted in the same gender distribution in the group. As it was said before, the participation of women belonging to group G-PBSL in the survey was 69% which means that the 83% of them completed the questionnaire; this percentage is 17 points higher than the percentage for men. We consider this fact as a proof of higher evolvement with the experience by women as they were more willing to contribute with their feedback after participating the second course. These results are in line with what has been reported elsewhere where SL experiences have been shown to be especially attractive to women in engineering studies and have actually been proposed as a strategy for increasing the presence of women in technical degrees [34,52].

The results for the seven questions in the reflection module qualitatively evidence the beneficial effect that, from both our and their point of view, the SL experience has produced in the students. When making professional decisions (item 3), the priorities shifted from those criteria traditionally applied by engineers (technical-economic) to sustainable criteria (environmental-social); being this change in priorities higher for students from G-PBSL group (67%) than students at G-SL group (48%). Nevertheless, in both groups, around 30% of the students consider technical criteria as the priority when making decisions. These results are in good agreement with those reported by Bielefeldt [43]. The other objective of the selected SL activity was to face students with diversity, in the sense of the lack of opportunities that people from disadvantaged groups have to live their lives with plenitude. More specifically, item 4 asked the students to elicit what aspect led them to consider themselves as privileged. For both groups, almost 50% of the students considered access to education and culture the most positive aspect of their own situation. However, when it came to the teaching goals of this work, the most remarkable aspect was that students who considered it a privilege to be able to influence

other people's lives with their professional decisions was not residual and moreover, increased from 8% in G-SL to 19% in G-PBSL.

It has been frequently highlighted that active teaching pedagogies applied to higher education can result in a decrease of the extension and depth of the knowledge that is transmitted to the students [18–21,53]. In this work, the positive impact of the SL learning activity on the outcomes of the course, with and without combining to PBL methodology, is quantitatively described at the beginning of this section. Moreover, students' perception agrees; both groups consider that the SL activity yielded a deeper settling of knowledge. However, there is a remarkable difference between the two groups; while the 8% of students in the G-PBSL group considered the SL activity more important than extending the content of the course, most of the students in the G-SL group consider the technical course contents as a priority. Moreover, 9% considered that SL should be excluded from the engineering curricula. The next block of questions (items 6–8) dealt with the institutional role that universities should adopt to promote the implementation of SL activities during higher education studies. Above 70% of the students considered SL beneficial for their integral education and demand an active role of the academic authorities in the implementation in the highest possible number of courses; this perception was 12 points higher among students belonging to G-PBSL group. Six percent of students in the G-SL group considered SL unnecessary in engineering studies, leaving this aspect of education to degrees that have traditionally been related to direct contact with people. The reflection module concludes by questioning students on the way they valued the teaching capacities of teachers. Most of the G-SL group (65%) prioritized teaching ability over other options while among the students in the G-PBSL group, the preferred option is a teacher with good skills in promoting civic values (40%). It is worth mentioning the residual importance that students gave to the recognition of the faculty in their areas of research and professionalism in their work.

The next module of the survey contained 15 questions intended to assess the impact of the SL activity on students. Moving from teacher-centered learning to student-centered learning increased the students' workload and their access to knowledge [19,32]. Surprisingly, 33% of the students in the GL-SL group considered that PBL entailed less work than taking the course with a conventional methodology. That could be the reason why more than 75% of the students belonging to this group were willing to participate in PBSL in other courses (instead of the pursued ability to get new competences in sustainability). On the contrary, when students in the G-PBSL group were asked about their willingness to continue working on the project in upcoming years, 70% said that they were willing to do so with no hesitation and in as much courses as possible; however, the other 30% left the decision up to the project supervisor or on their own workload. Questions intended to explore the level of satisfaction that the SL experience produced in the students (items 11–17) yielded interesting results. More than 90% of the students in the G-PBSL group have discussed it with their circle of friends and family, which can be interpreted as a signal of pride, satisfaction, and great engagement with the project; on the other hand, in the G-SL group, the percentage of students that considered it worth sharing with their extra-academic circle lowered to 46%. Most students in both groups considered that they had personal involvement in the project similar to their classmates (high or very high in both groups) while the satisfaction for participating or for the results of the project was almost 30 and 60 points, respectively, higher when students were deeply involved in the experience as PBL methodology requires. This additional value of the methodology results in close agreement with the findings of a previous study on this group [30]. Finally, the impact of the experience on the students' perception of the existence of social inequalities and how the teaching methodology affects that was worth mentioning: 92% of the students in group G-PBSL considered that the activity helped them to become aware of social inequalities, compared to just 26% in the G-SL group; moreover, 28% of the students in this group reported that the activity had no impact on that aspect of their awareness. These results mostly repeated when students were questioned on the role engineering profession in society in terms of its capacity for changing the lives of people. The next block of this module of the survey explored the impact of the experience on the solidarity-related behaviour and social

commitment of students (items 18–21). In good agreement with the previous results, 75% of the students in group G-PBSL against 37% of the G-SL group considered that their scale of priorities changed significantly; 50% of students in group G-PBSL versus 6% in group G-SL felt a significant improvement in their civic-awareness. Once again, when students were asked about the effect that the SL experience had in changing their social commitment, 82% in group G-PBSL and 35% in group G-SL considered the effect as significant. Slightly higher percentages of students in both groups (91% in G-PBSL and in 34% G-SL) stated an increase in their interest in participating in volunteering activities outside the university. It is remarkable that 60% of the students in G-SL barely demonstrated interest in volunteering activities, which reinforces the importance of the teaching methodology whenever the achievement of social responsibility and sustainability soft skills is the goal. The last block of the module (items 22–24) explored the possible changes in the perception that students have of the work that organizations are doing to improve the life of people with social disadvantages. More than 20% in both groups said that they were already aware of the role of these organizations in society, however, 77% of the students in the G-PBSL group see their previous perception strengthened versus 35% of the G-SL group (we assume that the word "change" was understood as "change towards a more positive perception"). This new perception can contribute to the results obtained when questioning students on seeing those organizations as a new job target: 84% of students belonging to group G-PBSL responded positively, while in group G-SL the result was 34 points lower. To conclude this module, students were questioned on their willingness to spread their experience with other peers and, once again, results demonstrated that the methodology applied can make big changes, 62% of the students in the G-PBLS group would encourage others to be enrolled in this type of experiences, while only the 13% of the students in the G-SL group responded positively to the idea.

An overall analysis of the answers to the open-ended questions brought to light the following main findings. As positive aspects of the experience, students who worked with the PBL methodology highlighted issues related to the attainment of generic competences. One student described it as a very positive "to get myself into a real situation as a designer, feeling that I am working on and actually facing real problems like this". Students also highlighted the following as the most positive parts of the experience: "Every time I worked on the project I thought that this product could be very useful for many people. And this helped me to move forward in my work." By contrast, students who worked with the conventional methodology found the topics related to specific competences to be the most positive. For example: "... to learn about the behaviour of materials in adverse situations and environments ..." and "... to learn during work in groups to find materials that you need for your design, to know its characteristics and what its uses could be ...".

On the negative side, students who worked with the PBL methodology felt that the groups should have been smaller for ease of collaboration. They also pointed to a lack of involvement by some members of the groups. Likewise, they considered that the project was not correctly planned, taking into account the rest of the tasks in the other courses of their semester. The G-SL group pointed to the fact that the activity entailed a greater workload in the whole of the course as a negative feature. This is in close agreement with the answers to item 10 from this group. Teachers considered this response inaccurate since they planned the work for the year course to avoid errors and pitfalls. On the other hand, it was assumed to be a perception held by the students who did not participate in the PBL methodology, because they had to deliver laboratory reports, set work, and monographs in the second semester more frequently than the students who were working on the project with the PBL methodology. With regard to the suggestions done by the students for future experiences, those who worked with the PBL methodology highlighted better planning of tasks within the context of all the courses of the semester. Students in the SL group focused on the aspects related to improving the specific competences of the course.

Finally, the feelings of students in the G-PBSL group when asked about the biggest impact of the course (including the SL experience) on their view of their lives and of the engineering profession can be summed up in this answer: "... it has changed me. My perception of industrial design has changed;

I really saw that I am capable of going on to be a design engineer and I know what I can expect to face in my work. Honestly, this project has totally changed my vision of my future and my career. It makes you realize that your work in the university and that all those hours that you spend attending classes aimed at making you a good professional in your career... ". Most of the responses from students in the G-SL group were concerned with the lessons learned from the use of materials in product design. There were some extreme cases such as that of one student who said "... the course has affected me negatively ..." and another who said "... making a bad decision by not doing things properly can have very serious consequences in the lives of other people ...".

4. Summary and Conclusions

This study investigated how the teaching methodology used in an SL experience affected the degree of attainment of University Social Responsibility competences in core courses taken by students of an engineering degree. Based on an anonymous survey that collected the perception of the students, it sought evidence of empirical foundations regarding whether and how a PBL methodology applied to a SL experience could affect the acquisition of social responsibility-related skills with respect to a SL experience implemented as a regular exercise. The analysis compares the answers given by a group of students called G-PBSL, whose members carried out the experience through an active PBL methodology along two courses, with those of a second group, called G-SL, who underwent the experience as part of a normal classroom assignment in only one course.

Common perceptions and some clear differences were observed between the two groups of students, leading to the most remarkable conclusions of this work. The students consider the integration of SL activities into their university curricula positively as long as they do not result in a lack of attention paid to the specific knowledge content of the courses. They appreciated their teachers both being good teachers and transmitters of values of civic-mindedness. In their opinion, it was the responsibility of the academic authorities to implement SL activities and were mostly willing to carry out further similar experiences and encourage colleagues to participate. Students who were involved more extensively in the SL activity were more satisfied with the work done and the results obtained, regarding the acquisition of social, specific, and generic competences. We also consider it important that students were able to make distinction between an SL experience carried out under supervision and marked as other assignments of the course, and the volunteer work they can do outside the university, and accept that it could be awarded up to a limited number of credits.

SL activities could enhance awareness among students of social circumstances, such as the recognition of their privileged situation, the social responsibility behind their decision-making in the exercise of their profession, their ability to influence the lives of people through their profession, greater willingness to participate in voluntary activities, greater recognition of the work carried out by organizations such as the promoter of the project, etc. This enhancement of awareness was greater in the G-PBSL group, in which students worked more extensively on the SL activity.

As a final conclusion, SL activities could enable teachers to work on the formative side of sustainability, promoting the acquisition of values of responsibility, solidarity, and social commitment in students. The degree of competence that students acquired depended on the methodology used. Students who worked with the SL experience for a semester as one of assignments in the course, with a workload comprising 20% of their final grade, were less sensitive to the URS values worked on than those who additionally worked on the SL activity in another course in the second semester, with a workload of 50% of the final assessment, and using a PBL methodology. The use of active learning methodology for fostering achievement of soft skills was successful in reinforcing the acquisition of technical competences. This fact was quantitatively evaluated in the final marks and agrees with the perception of the students. Moreover, it was evident that when students felt that their work was important or could impact other people positively, their engagement was deeper, they felt proud, and were willing to share their experience with their family and friends outside university.

It is worth mentioning that in our sample, women were more willing than men to participate in SL activities and to contribute with their own perception and feedback to the study. This fact can be used as a valuable strategy for increasing the presence of women in technical degrees and a way to work on the gender issue and URS simultaneously. However, it should be taken into account that the sample used in this work was formed by students enrolled in an Industrial Design and Product Development degree, in which representation of women is higher than the average in engineering degrees. Thus, these results should be explored and extended to other engineering degrees traditionally less attractive to women.

It is advisable to monitor students in the coming years regarding their memories of the SL activity and their current commitment to their surrounding community. This suggestion will be put forward to academic authorities to be considered within the Sustainability policies of the university.

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

Appendix A

Table A1. Questions in the survey.

SURVEY
Demographic characteristics
1. Age
(a)　　18–19 (b)　　20–21 (c)　　22–23 (d)　　24 or more
2. Gender
(a)　　Female (b)　　Male
Reflection Questionnaire
3. If you had to apply one of these criteria to the exercise of your profession, which would you choose?
(a)　　Technical (b)　　Economic (c)　　Environmental (d)　　Social

Table A1. *Cont.*

SURVEY

4. As a university student in a Western country, you are a privileged person. Which of these factors do you feel most privileged about?

(a)   Having your basic needs covered
(b)   Having access to education and culture.
(c)   Being able to influence other's people lives with your professional decisions
(d)   Freely choosing your profession.

5. A project that responds to the needs of society (Service-Learning) can restrict the depth with which some parts of the course are worked on. Do you consider that:

(a)   Technical knowledge is the most important thing.
(b)   It is better to work on the social responsibility than on technical content.
(c)   The involvement of students in these activities helps knowledge to be retained over time, so the knowledge obtained may be less but is more durable.
(d)   Acquiring social commitment should not be part of the engineering curriculum, as it depends on the sensitivity of each person.

6. Do you think that engineering studies at universities should include compulsory working and assessing activities aimed at meeting the needs of society (Service-Learning) for all students? In how many courses?

(a)   None
(b)   1 to 3
(c)   4 to 5
(d)   As many as possible

7. Do you think that the mission of the university should in some way include actions aimed at helping students to commit to social responsibility?

(a)   Yes, on all degrees
(b)   Yes, as long as it does not compromise academic content
(c)   Only on those studies related to direct contact with people (teaching, health, labor relations, psychology, social work, etc.)
(d)   This is not the university's job.

8. Do you think the university should award credits to students who actively participate in associations with some kind of social commitment (cultural associations, volunteering, student associations, NGOs, etc.)?

(a)   Yes, it should be mandatory for all students to earn their degrees.
(b)   Yes, up to a maximum of 5% of the credits for your qualification.
(c)   Not unless it is directly related with your studies.
(d)   No, the university should be for studying.

9. How do you think the attitude of the university faculty affects your perception of the role of universities in society?

(a)   The most important thing is for them to be motivators to help students be better citizens.
(b)   The most important thing is for them to be highly recognized in their field of knowledge.
(c)   The most important thing is for them to be diligent in their work.
(d)   The most important thing is for them to be good teachers.

Table A1. *Cont.*

SURVEY

Assessment Questionnaire

10. G-SL A group of your classmates are voluntarily taking a project-based learning methodology. Are you aware of this and do you know more or less how much additional work this methodology entails?

(a)   Yes, I know about the experience and I think that it entails much more work than studying the course in the conventional way.
(b)   Yes, I know about the experience and I think that it entails less work than studying the course in the conventional way.
(c)   Yes, I know about the experience, but I do not know exactly what they have done or how much work was involved.
(d)   I did not know.

10. G-PBSL If you had the option of continuing the project next year in another course, would you be willing to do so?

(a)   Certainly not.
(b)   It depends on the teacher.
(c)   It depends on the amount of work.
(d)   Certainly.

11. G-SL If you know about the experience and believe that it involves more work than studying the course in a conventional way, for how many courses would you choose this methodology in the years to come?

(a)   None.
(b)   Between 1 and 3
(c)   Between 4 and 5
(d)   As many as possible

11. G-PBSL Having undergone the experience and realized that it requires a lot of work but opened your eyes to other aspects of your profession, for how many courses would you choose this methodology in the years to come?

(a)   None.
(b)   Between 1 and 3
(c)   Between 4 and 5
(d)   As many as possible

12. With whom have you discussed in some detail the experience that you were undergoing this year?

(a)   Relatives and friends
(b)   Friends only
(c)   Only colleagues from the university
(d)   Only with the working group

13. What has been your degree of personal involvement and dedication to the experience?

(a)   Above average
(b)   Average
(c)   Below average
(d)   The minimum

14. How high is your level of satisfaction with your involvement in the experience?

(a)   Very high
(b)   High
(c)   Medium
(d)   Low

Table A1. *Cont.*

SURVEY

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15. How high is your level of satisfaction with the end result of the experience?

(a) Very high
(b) High
(c) Medium
(d) Low

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16. How do you think that having undergone this experience has affected your awareness of social inequalities?

(a) Very much
(b) Quite a lot
(c) Very little
(d) Not at all

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17. How do you think undergoing this experience has affected your awareness of the role of engineers in society?

(a) Very much
(b) Quite a lot
(c) Very little
(d) Not at all

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18. How much do you think undergoing this experience has affected the way in which you relativize the importance of your problems?

(a) Very much
(b) Quite a lot
(c) Very Little
(d) Not at all

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19. How much do you think having this experience has improved your civic-mindedness?

(a) Very much
(b) Quite a lot
(c) Very Little
(d) Not at all

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20. How much do you think undergoing this experience has affected your involvement with society?

(a) Very much
(b) Quite a lot
(c) Very Little
(d) Not at all

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21. How much do you think that undergoing this experience has affected the possibility of your participating in an association/entity engaged in this type of activities at the end of the experience?

(a) Very much
(b) Quite a lot
(c) Very Little
(d) Not at all

Table A1. *Cont.*

SURVEY
22. Has what you have seen and learned in this experience changed your sensitivity to the work that socially committed organizations do?

(a)   Yes, my point of view has changed a lot.
(b)   Yes, it reinforced what I thought.
(c)   No, I was already fully aware of their role.
(d)   No, the experience did not show me this.

23. How much do you think that undergoing this experience has affected other employment possibilities?

(a)   Very much
(b)   Quite a lot
(c)   Very Little
(d)   Not at all

24. Would you encourage other partners to participate in SL experiences?

(a)   Yes, without hesitation.
(b)   Yes, but I would warn them of the difficulties.
(c)   I would neither encourage nor discourage them.
(d)   No, it is not worthwhile.

Open questions

25. What would you highlight as the most positive part of the experience?

26. What would you highlight as the most negative part of the experience?

27. What would you change for upcoming years?

28. What do you think has been the greatest impact that this experience has had on your view of life and of the engineering profession?

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