Service-Learning Project (APS) oriented to the Degree in Building for the recovery of End-of-Life Tyres

Proyecto de Aprendizaje-Servicio (APS) orientado al Grado en Edificación para recuperación de Neumáticos Fuera de Uso

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HIGHLIGHTS

- The management of end-of-life tyres has become a major challenge for today's society.
- The APS methodology and its application possibilities in the classroom are described.
- The APS methodology combines university teaching with community service.

TITULARES

- La gestión de los neumáticos fuera de uso se ha convertido en un gran reto para la sociedad actual
- Se describe la metodología APS y sus posibilidades de aplicación en el aula
- La metodología APS combina enseñanza universtiaria con servicio comunitario

RESUMEN

La metodología de Aprendizaje-Servicio (APS) hace posible combinar los procesos de enseñanza universitario con el apoyo y servicio a las necesidades de la comunidad. En este trabajo se plantea una propuesta educativa que prentende impulsar la gestión eficiente de los Neumáticos Fuera de Uso, a través de la enseñanza universitaria en el Grado en Edificación. De esta manera, se plantea la metodología necesaria para llevar esta experiencia APS en el aula, describiendo tanto las herramientas de apoyo como las fases de implantación de la propuesta en un semestre académica. Adicionalmente, en el trabajo también se describen los posibles métodos de evaluación que pueden ser aplicados en el contexto universitario, con el objetivo de servir como punto de apoyo a aquellos docentes interesados en la implantación de esta metodología. Finalmente, cabe destacar que durante todo el documento se han tenido en consideración los criterios de sosteniblidad y de servicio comunitario vinculados con esta metodología.

Palabras clave: *Aprendizaje-Servicio, Neumáticos Fuera de Uso, Grado en Edificación, innovación educativa*

ABSTRACT

The Service-Learning (SL) methodology makes it possible to combine university teaching processes with support and service to the needs of the community. This paper presents an educational proposal that aims to promote the efficient management of End-of-Life Tyres through university teaching in the Bachelor's Degree in Building. In this way, the methodology necessary to carry out this SL experience in the classroom is proposed, describing both the support tools and the phases of implementation of the proposal in an academic semester. In addition, the work also describes the possible evaluation methods that can be applied in the university context, with the aim of serving as a point of support for those teachers interested in implementing this methodology. Finally, it should be noted that the sustainability and community service criteria linked to this methodology have been taken into consideration throughout the document.

Keywords: *Service-Learning, Service-Learning, End-of-Life Tyres, Bachelor in Building, educational innovation*

1. INTRODUCTION

Service-Learning (SLA) methodology is committed to learning situations development in which students are trained by working on the society real needs with the faithful aim of improving it. Thus, in order for Service-Learning to be developed in high education context, some fundamental elements are required such as [1]:

- **Entities** that favour collaboration and in which students can contribute by performing a community service.

- A **project,** which must promote knowledge acquired implementation at the classroom. These projects development require a space where to develop, time to relate to the agents involved and an activity, structuring lines of work to prioritise objectives.

- **Commitment Attitude** and cooperation by teaching staff, students and entities involved.

- A **critical nature and self-evaluation**, to periodically reflect on the activities being developed, their real usefulness for students and society, and the possibility of serving as new projects starting point.

It can be highlighted differences between SLA and other misguided approaches. To properly understand this process, it is necessary to analyse Learning and Service two parts that comprise the methodology, as shown in Figure 1.
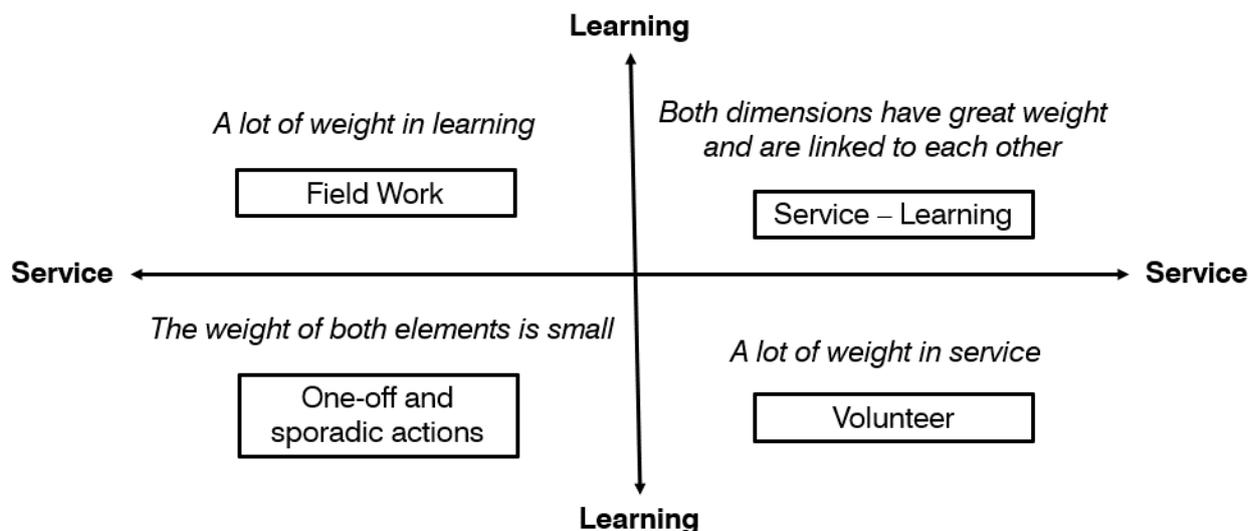
Fig. 1. *Learning-Service characteristics [2].*

Regarding this, Puig, Martin, and Battle (2008) propose a development process for PLA project implementation of at high education classroom [3]. Phases involved in this methodology implementation can be summarised:

Stage 1: Preparation / Planification

Identifying a real need for the society or collective where the project is to be developed. This can be done by joining an existing project, or by exploring new ways of working, defining services and original learning. In this stage, it is possible to reflect on the real scope achieved and the commitment with collaborating entities.

Stage 2: Execution / Implementation

It requires coordination between involved agents and flexibility to adapt to possible inconveniences. It should culminate with a reflection on the actions carried out and a communication process evaluation.

Stage 3: Multifocal assessment / Closure

Evaluating the results obtained after the experience, giving equal weight to service and learning, as well as sharing the results obtained and disseminating the project. Evaluation process includes not only the group and work, but also the participants' own self-evaluation.

Within the development process presented, LSA educational proposal goes beyond traditional educational methodology. As P. Mª. Uruñuela [2] points out, "LSA is also an educational philosophy, which emphasises certain fundamental aspects and, at the same time, is also a strategy for community development".

It is therefore an active, student-centred methodology that promotes responsibility, exploration, reflection, and social action by people involved. Furthermore, it has a markedly practical nature. Educating in values by putting the knowledge acquired into practice, it is necessary to exercise it. The students' personal experience and reflection are fundamental to their learning.

1.1. End-of-Life Tyres and the Sustainable Development Goals

On September, 25th 2015, 193 UN states adopted 17 global goals (Figure 2) aimed at eradicating poverty, protecting the planet and ensuring prosperity for all within an agenda for sustainable development to be achieved by 2030.

Fig. 2. Sustainable Development Goals (ODS) [4].

Thus, there is a faithful relationship between the SDGs and SL, as some authors point out. More specifically, Batlle (2019) points out that: "...service-learning provides a compass for talent and helps us to direct excellence and creativity towards social transformation, it becomes a useful tool for aligning education towards the SDGs and for turning awareness into commitment". [5].

In Spain, approximately 300,000 tonnes of end-of-life tyres (ELTs) are generated annually [6]. Until the arrival of the first environmental legislation on recycling and reuse in Spain, the last holders of ELTs, usually garages, had to take care of them and bear their proper management costs, either by their own means or by paying an authorised manager. There was little interest in the waste generated due to the underdeveloped recovery markets and processing high cost [7]. As a result, management infrastructures were non-existent and only those that generated a profit margin (retreading, second-hand sales, etc.) were managed correctly. The rest, ended up in landfills or were reused as parapets in ports and speedways, overlooking their value as secondary raw material or recovered fuel.

Currently, Royal Decree 731/2020 of 4 August [8], aims to provide a more effective response to doubts arising from this waste management. However, there is still work to be done and this environmental problem has become one of the great challenges for developed countries. Recent data show that about 55% of all tyre waste is recycled [9], being the most widely used end-of-life tyre (ELT) recovery strategy among

EU-28 countries. Other options are energy recovery (35%) or retreading (6%). As a consequence of the recycling of ELT, following materials are mainly obtained: rubber granules and powder, metallic fibres, and textile fibres, all of them with a wide potential of application in industry.

Therefore, the aim of this work is to carry out an analysis exploring possible ways of using materials obtained after ELT treatment, evaluating their advantages and disadvantages, and redesigning traditional construction materials production process to incorporate materials from ELT in their manufacture.

It is, therefore, an educational proposal framed within the LSA methodology, and it tries to solve a real problem derived from ELT management. This work presents guidelines for developing this experience at high education classroom, as well as possible planning and evaluation methods to use during its implementation.

2. METHODOLOGY

As aforementioned, this educational proposal main motivation is bringing ETSEM students closer to new applications development to promote municipal solid waste in the construction sector recycling. In addition, the aim is to transmit to students recovering solid urban waste importance as a source of new raw materials and warning them about the need to find new solutions for their application in industry. All of this is linked to activities development and research work that allow new alternatives for the recovery and recycling of municipal solid waste to be offered.

The contents worked on in this project, broken down by the subjects involved in its development, are as follows:

- **Strategic Management**: Corporate Social Responsibility (CSR), business ethics, sources of competitive advantage and the

relationship between business and the environment.

- **Sectoral Policies**: Environmental Management Policies and Waste Management Regulations in the Community of Madrid.

- **Maintenance**: Maintenance of building systems.

- **Monitoring of buildings for energy certification**, **safety, and rehabilitation**: Development of new measuring equipment applied to buildings.

In addition, in Final Degree and Final Master's Degree Projects linked to the project, the contents of chosen subject will be developed according to students profile.

2.1. Teaching Methodologies

For this Service-Learning proposal development, various complementary methodologies can be used to make the classroom more dynamic. The following are some of the most commonly used ones:

- **Learning By Doing**, giving prominence to the students' learning, making them participants and responsible for it. In this case, the learning is associated with community service action to improve ELT recycling.

- **Design Thinking**, approaching is a co-creative approach to dynamic problem solving, leading systematically to innovation, integrating science, technology and the humanities. Of course, related to the search for new avenues of application for these wastes.

- **Challenge-based learning**, it consider that solutions must be implemented together with environmental and socio-economic sustainability objectives.

2.2. Activities to be developed characterization.

First, from a LSA perspective, learning activities that can be incorporated into the development of this research work and which are related to the four main areas presented below are proposed:

1. **Learn to know**: knowledge of business, construction, and physical fundamentals to develop ELT materials in building. It is seen as a challenge for today's society and a specific problem that needs to be solved, showing students the social work of organisations such as SIGNUS.

2. **Learn to do**: skills for manage projects, such as time planning, self-management of emotions, organisation of work, activity evaluation, etc. In short, specific skills and competences linked to the recycling and recovery of ELT acquired.

3. **Learn to be:** competences related to personal autonomy, such as self-esteem, perseverance, effort or criticism management. Enabling students to internalise solidarity values and respect for the environment.

4. **Learn to live together** : developing skills such as teamwork, communication in public, empathy, and solidarity.

On the other hand, reflection activities are important for students to assimilate concepts taught and to assimilate the competences worked on during the project. These reflection activities will serve to slow course's accelerated pace and being conscious. Thus, lead to an ELT recovery and recycling solutions seek reinforcement and the need for everyone to be part in recycling initiative.

More specifically, these reflection activities can be developed during the course as follows:

- Meetings with students: Periodically to check activity progress.

- Records of difficulties and solutions: by means of questionnaires and questions in class, seeking to improve the proposal put forward.

- Written reports from the students at the end of the activity.

- Records of lessons learnt, through the preparation of a classroom diary.

- work Presentations to their classmates, so that questions can be asked, and possible doubts resolved.

- Initial brainstorming to address possible solutions to ELT recovery and recycling to find out starting point with the students and establishing an action joint line guided by the teaching staff.

3. PROPOSAL IMPLEMENTATION

This proposal development is designed to be within the time, credits, and space of involved subjects in its implementation. To this end, the teachers involved should first ask themselves initial questions that will enable them to contextualise the proposal and effectively include it in the subject. The following reasoning process can be applied to other similar projects to be implemented in high education teaching context.

- How many hours will students devote to LSA - hours/credits?

- How much weight will the LSA have in final assessment?

- Will it be offered as an optional or compulsory activity?

- Will they create a new project or join an ongoing one?

- Which entities are involved?

- How much of the subject will they apply and discover through the LSA process?

- Will there be more narrow or broad activities where they can make more decisions?

- How will follow-up be done?

It should be noticed that these questions are taken from LSA guide proposed by Universidad Politécnica de Madrid [10]. In any case,

development of proposed activities in this work are designed to take a semester.

In this sense, development phases proposed for this work are shown below:

1st Stage: incorporating Service-Learning methodology into subjects programming, considering logical reasoning scheme outlined above. This process core is the efficient management of ELTs and the search for possible solutions for their use in building. It is therefore a question of applying learnt knowledge in both technical subjects and business administration subjects to contribute to a real need in society linked to this waste management.

2nd Stage: brainstorming and proposal implementation, contacting main actors involved and coordinating actions to efficiently implement the service. This phase should be developed considering needed time to acquire subjects' competences.

3rd Stage: Action Development, service implementation and community work, as well as subjects' development and teaching, using the proposal for ELT management as a guiding thread. In this section, which will be developed during the final part of the semester, action itself is developed and activities must be evaluated step by step, assessing whether the expected knowledge has been acquired and planned and useful service has been carried out.

4th Stage: Results dissemination, proposal evaluation and new initiatives promotion and improvement proposals allowing the project to continue.

Time management in classroom is fundamental, as traditional theory classes must be given to explain and clarify key concepts, but as much time as possible must be devoted to autonomous work and to resolve challenges.

3.1. LS Activity assesment

Three stages can be considered within the evaluation process: (1) evaluation and reflection

on learning; (2) teacher's activity evaluation; and (3) LSA project evaluation.

In the first stage, as highlighted by Morín et al. [11], "reflection takes on great importance in service-learning processes as it enables the integration of service with academic learning by promoting the development of knowledge, skills and cognitive capacities". Along these lines, Figure 3 shows an outline of the activities to be developed to encourage reflection on the LSA process, which was developed by Eyler [12].
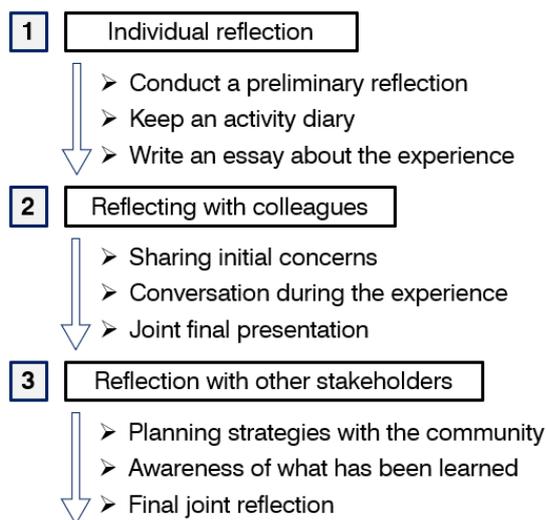

Fig. 3. *Reflection process in LSA.*

During self-assessment process, writing a portfolio becomes a special interest tool. This is a written document in which the essential points of the experience are collected. Thus, allows the students be conscious of LSA activity development weekly. In this way, a continuous record of the activities can be kept, which favours continuous assessment.

For the intervention evaluation with the collaborating entity, the following coordination mechanisms will be used:

- Frequent meetings between the university team and company team, where service is provided to communicate the project progress, difficulties and needs that arise.

- Final questionnaire to ascertain the collaborating entity's impression of the results obtained and the achievement level of objectives set.

- Student's activity records and contribution to the SDGs.

- Records of results achieved. At the end of the project, a results report will be issued and sent to the organisation for joint study with the university researchers. From this study, new lines of work will be obtained for the following academic year.

- Active participation of the members of the companies involved in the delivery of seminars and talks to students, where they will have access to the facilities and will be able to see the level of development of the proposal at any given time.

In any case, to conclude this section, it is worth noting a quote from Shuell, 1986, [13]: *"for students to achieve the desired outcomes in a reasonably effective manner, the teacher's fundamental task is to get his or her students to engage in the learning activities that are most likely to lead them to achieve the intended outcomes.... What the student does is actually more important in determining what he or she learns than what the teacher does"*. This puts the focus on action, rather than on the content taught by the teacher. The focus is on learning based on the student's experience.

3.2. Social impact

This teaching proposal makes it possible to highlight and analyse the importance of transforming waste into resources for direct application in the value chain. In this way, the visualisation and recycled materials' use importance is strengthened, building a shared vision among involved students to deal with the problem, as well as favouring the search for solutions that allow the use of ELT materials in sustainable construction materials' production. This is an activity with a marked social character due to its contribution to sustainability and the Circular Economy.

To know the activity's impact in this type of activities framework, following tools can be used, which can be adapted by teachers interested in the methodology presented:

- Satisfaction questionnaires to the recipients, which assess students' involvement level, their awareness of ELT recycling and their commitment to act in sustainable development pursuit.

- Reports from entity on the objectives achieved and visualisation of found solutions, which allow the incorporation of ELT materials in new construction materials design.

- Registration of tangible products, especially those related to the new construction materials characterisation that incorporate ELT materials in their composition. As well as possible inventions registers derived from the project activity and the recycling possibilities.

4. CONCLUSIONS

This work has presented the guidelines for developing a Service-Learning project in the university context linked to efficient waste management. During the development of this proposal, it has been possible to observe how the APS methodology can be understood as a teaching philosophy that, including other active tools, promotes the development of activities aimed at improving today's society. More specifically, this work has linked university teaching in the degree in Building with the efficient management of the NFU as an action aimed at complying with the Sustainable Development Goals.

In this sense, the proposal presented, and the evaluation methods described are intended to serve as a support point for university teaching so that those lecturers interested in this methodology can use the ideas presented in this work to introduce PSA in the programming of their subjects. Although it is true that the proposal is developed for a particular context, the APS

methodology can be applied in any university environment regardless of the subject, as long as the focus of learning is on developing a useful action for a real environment in society.

Aknowledgement

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