



# Four-Dimensional Learning, a Response to Social Responsibility in Learning

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**Abstract.** Corporate Social Responsibility can be considered as the integration in an organisation of social and environmental concerns in their operations and in their interaction with their stakeholders on a voluntary basis. Universities, as leaders in higher education and scientific advancement, have long adopted this social responsibility from several points of view, particularly training their students. Our research focuses on effectively introducing the social factor in the training of engineers. In order to do this, four principles or dimensions define our proposal: Project-Based Learning, that uses an engineering project as a central element of learning; Transversal Learning, that uses a project defined between several disciplines; Professional Learning, which takes place in an environment that is very close to the professional context; and Service Learning, in which the academic results not only benefit the learner but also the society. In short, we propose a transversal project-based learning experience developed in collaboration with an external organisation that contributes its problems and collects the solutions developed by the students. As a consequence of this collaboration, the students are introduced to a real professional environment, and provide both a strategic vision of the organisation and innovative solutions to their problems. In addition, the institution has a social character as it is a non-profit organisation that works with disadvantaged people (Spanish Red Cross), which turns the experience into a service learning experience. The result is encouraging and very positive, as evidenced by the opinions of students, teachers and the organisation that hosts the experience.

**Keywords:** Corporate Social Responsibility in Universities ·  
Project-Based Learning · Transversal Learning ·  
Professional Learning · Service Learning

## 1 Introduction

Although there is no unique definition of Corporate Social Responsibility (CSR), it can be considered as the integration in an organisation of social and environmental concerns in their operations and in their interaction with their stakeholders on a voluntary basis [1]. For the European Commission, CSR provides the foundations of an integrated approach that combines economic, environmental and social interests to their mutual benefit. It opens a way of managing change and of reconciling social development with improved competitiveness.

Other terms used for CSR in specialty literature are corporate responsibility, corporate citizenship, corporate sustainability or corporate sustainable development [2]. It is important to note several issues about CSR: it covers both social and environmental aspects, it must be aligned with the organisational strategy, it has a voluntary character and it concerns how the organisation interacts with their internal and external stakeholders.

Universities, as leaders in higher education and scientific advancement, have long adopted this social responsibility from several points of view. The social dimension of the University is adopted through its teaching, research and cultural extension functions. For this reason, it must comprehensively incorporate aspects relating to professional ethics, the development of key competences and entrepreneurial initiatives, as well as the impact of technologies and processes in terms of social and environmental sustainability, being a driving force for change for future professionals [3].

Our research focuses on the field of engineering, although it can be extended to any other field. Since engineers must be socially responsible, but they must also know how to operate in a professional environment, we make a proposal to effectively introduce the social factor in the training of these professionals. In order to do this, four principles or dimensions define our proposal (hence the name Four-Dimensional Learning):

- Project-Based Learning, as a teaching methodology that uses an engineering project as a central element of learning.
- Transversal Learning, which uses a project defined between several disciplines, which brings it closer to a real project, in which transversal concepts participate.
- Professional Learning, which takes place in an environment that is very close to the professional context in which future engineers will develop their work once they have finished their studies.
- Service Learning, as a way of endowing the project with a social character, in which the academic results not only benefit the learner but also the society.

In order to incorporate social responsibility in the training of future computer engineers, we propose the coordination of transversal subjects, developed through a project that articulates all the activities of the subjects. In short, it is a transversal project-based learning experience.

In addition, this project is developed in collaboration with an external organisation that contributes its problems and collects the solutions developed by the

students. As a consequence of this collaboration, the students are introduced to a real professional environment, and provide both a strategic vision of the organisation and innovative solutions to their problems. In addition, the institution has a social character as it is a non-profit organisation that works with disadvantaged people (Spanish Red Cross), which turns the experience into a service learning experience.

As a consequence of their project, the students develop their skills related to the social responsibility that every engineer must have.

The result, after several years of experience is encouraging and very positive, as evidenced by the results of satisfaction of students, teachers and the organisation that hosts the experience.

The document is organised as follows: Sect. 2 presents the background of the research, including a short review on the main concepts. The context is presented in Sect. 3, with a brief description of the subjects. Section 4 is devoted to explain our proposal in depth. Finally, some conclusions are highlighted in Sect. 5.

## 2 Background

### 2.1 Social Responsibility and Higher Education

In recent years, social responsibility has gained prominence in many fields, and particularly in university environments. The university governance is becoming aware of this need and there is a proliferation of actions related to CSR, organic units dedicated to these actions and specialised training in this field. However, there is no consensus on the concrete definition of this concept or on how to implement it through specific strategies and actions. Each institution and each author determine its own orientation.

For example, [4] tries to facilitate understanding of the concept of CSR as a strategic challenge for universities and conducts a literature review in which he detects three major perspectives for this concept: managerial, transformational and normative. The management approach is concerned with analysing the impact of university work in society, especially through accountability of their actions and decisions to their stakeholders. The transformational approach, however, focuses on reviewing the university's contribution to debate and reflection to achieve a more sustainable and just society. Finally, the normative approach focuses on the development of normative frameworks from the university as an axis to do the right thing in life in society, through the establishment of national or global university networks around social responsibility.

The transformational perspective is especially interesting to us because it is the one we have taken in our work. Gaete Quezada [4] classifies the different initiatives into four areas: training, research, social leadership and social commitment. In the area of training, in which our proposal is included, the main actions are related to Service Learning and the relationship of the university with society. Service Learning favours the preparation of students so that they insert themselves into society as responsible citizens and contribute to its sustainable development for mutual benefit.

For its part, González Alcántara et al. [3] consider it important to integrally incorporate aspects relating to professional ethics, the development of key competencies and entrepreneurial initiatives, as well as the impact of technologies and processes in terms of social and environmental sustainability. This author has studied the situation of CSR in Spanish universities and has identified a set of good practices for four axes: academic and pedagogical training, research and dissemination, organisation management and social participation. For the academic and pedagogical training axis, it considers as good practices the existence of degrees in Social Responsibility, or subjects that promote the values of citizenship, responsibility and social commitment in other degrees. With regard to research and dissemination, good practices are considered to be research actions aimed at achieving benefits for society (collaboration with companies, research groups in CRS and the existence of ethical committees), and dissemination actions (websites, journals, conferences and other publications). The good practices related to the axis of organisation management include dialogue with interest groups, commitment with workers, integration of CSR in management or transparency. Finally, on the axis of social participation, good practices are identified as actions that allow society to be participants in the university, not requiring them to be students or staff, as well as measures to encourage volunteerism and cooperation.

Particularly, the University of Alicante, in which this proposal is framed, is a public and socially responsible institution, whose mission is the integral training and development of its students. Not only in knowledge and disciplines, but also the promotion of the critical awareness, social responsibility, health and sustainability principles, to contribute effectively to the welfare of the society where it is inserted. It should also be added the guarantee of personal dignity, the free development of persons, without any discrimination, and finally, the right to effective equality between women and men. Research is another basic principle to increase improvement of knowledge. On the one hand, by its transfer through teaching. On the other hand, the direct contribution of the University to the society through its inescapable commitment to the cultural, scientific and technological development. In this way, thanks to the collaboration with other social agents, such research can be realised in innovation for sustainable development and the improvement of the quality of life [5]. The references that guide the values of the University of Alicante are designed in order to foster the quality of a public university. Among these, it can be found solidarity and sustainability.

This initiative is part of the curriculum of Masters Degree in Computer Engineering, among which the following competences stand out [6]:

- Ability to project, calculate and design products, processes and installations in all areas of computer engineering.
- Ability to manage works and computer systems installations, complying with current regulations and ensuring service quality.
- Ability to manage, plan and supervise multidisciplinary teams.

- Capacity for the elaboration, strategic planning, direction, coordination and technical and economic management of projects in all areas of Computer Engineering following quality and environmental criteria.
- Capacity for the implementation, direction and management of manufacturing processes of computer equipment, with a guarantee of safety for people and goods, the final quality of products and their homologation.
- Ability to understand and apply the ethical responsibility, legislation and professional deontology of the activity of the profession of Computer Engineer.
- Ability to apply the principles of economics and management of human resources and projects, as well as legislation, regulation and standardisation of information technology.
- Capacity for strategic planning, elaboration, direction, coordination, and technical and economic management in the fields of computer engineering related, among others, with: systems, applications, services, networks, infrastructures, or computer facilities and software development centres or factories, respecting the proper compliance with quality and environmental criteria and in multidisciplinary work environments.
- Ability to manage research, development and innovation projects in companies and technology centres, guaranteeing safety for people and goods, the final quality of the products and their homologation.
- Ability to design, develop, manage and evaluate certification mechanisms and guarantee security in the treatment and access to information in a local or distributed processing system.
- Capacity to contribute to the future development of information technology.
- Ability to integrate knowledge and deal with the complexity of making judgements based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgements.

The concepts of ethical, social and professional responsibility, deontology, regulations, sustainability, safety, standardisation, resource management, innovation, service, and transference are present in every subject and area of the curriculum. In this context, the aspects of CSR in a wide sense are fully justified in the curriculum of Computer Engineering. A good way to complete the training of these future professionals may be the development of transversal projects as a service for non-profit organisations and we already have some previous experiences about this question. For instance, we have experience in achieving the social inclusion of disabled people, as part of the social responsibility of future engineers, through the realisation of the final degree project in collaboration with associations of disabled users, in particular through the design and development of adapted video games [7]. The students are trained in the social responsibility but also solving some problems of inclusion in the collective of disabled users (such as the access to digital entertainment) and carrying out an in-depth study about the interaction problems for these users, providing concrete and practical solutions. As a result, the experience has served to introduce the aspects of social responsibility in the curricula of engineers in a very effective way.

## 2.2 Project-Based Learning

The vertiginous evolution of today's society is demanding increasingly new skills from professionals. These professionals of the future, among other skills, need to manage change appropriately, collaborate and cooperate with other professionals, integrate different points of view, operate in technological, multidisciplinary and multicultural environments or be autonomous in the search for information and learning. In short, they must be prepared to adapt to changing environmental conditions with high uncertainty.

One of the teaching methods that best adapts to these characteristics is Project Based Learning (PBL) since it allows to cover the key aspects of which we have spoken, with a professional project as objective, with an active role of the student, cooperative and interdisciplinary, and with an adequate use of technological resources.

There are numerous successful works of application of the PBL methodology in Engineering studies. The PBL develops skills such as encouraging teamwork, encouraging autonomous learning, reinforcing oral and written communication, and improving the ability to plan time, among others [8,9]. In addition, the PBL allows an approximation to the professional practice of future engineers and to develop a finished product that can be included in their personal portfolio [10].

## 2.3 Transversal Learning

Traditionally, curricula are divided into subjects that divide knowledge into stand-alone partitions. However, knowledge is not compartmentalised, and real problems always need the help of different branches of knowledge. In contrast to this classical division into subjects, transversal and multidisciplinary learning enriches the formative work in such a way that it connects and articulates the knowledge of the different disciplines and establishes connections between mere instruction and integral formation.

Multidisciplinary refers to the broad spectrum of scientific fields that are collectively employed to provide heterogeneous training experiences for learners [11]. Several studies have proven that multidisciplinary projects have made a positive difference in both teachers and students, increasing their motivation [12,13].

Transversality is a related and wider concept. It seeks to see the entire educational experience as an opportunity for learning to integrate its cognitive and formative dimensions, which has an impact not only on the established curriculum, but also on the educational culture and all the actors that are part of it [14].

The transversal dimension of learning not only implies a change in educational practice, but it must play a fundamental role in the profile of the future citizen. In this sense, one of the most innovative options of the current educational proposals lies in firmly advocating an integral formative action that takes into account both the intellectual and moral aspects in a balanced manner and promotes the harmonious development of the students' personalities, without

forgetting the problematic social context in which they live. At this point, the direct involvement of learners with social agents through Transversal and Service Learning implies a decisive humanising orientation of educational practice. Some authors define this Transversal Learning from a triple perspective [15]): in the attitudinal contents of each curricular area, in some optional subjects and through the so-called transversal axes, teachings or subjects. In our case we achieve transversality through the integration of several subjects, proposing unique projects that deal with different aspects and analyse common cases from different perspectives [10].

## 2.4 Professional Learning

Profession is defined as a vocation requiring specialised knowledge and often long and intensive preparation including instruction in skills and methods as well as in the scientific, historical, or scholarly principles underlying such skills and methods, maintaining by force of organisation concerted opinion high standards of achievement and conduct, and committing its members to continued study and to a kind of work which has for its prime purpose the rendering of a public service [16].

Professional Learning is a cognitive-affective process of the human being or a collective, through which the appropriation and systematisation of the professional experience and technological culture is produced, favouring that the learner develops his labor competences, immersed in the real processes of activity and communication of a company [17].

Professional Learning has the advantage that the learner obtains the work and professional skills necessary to perform successfully in the work activity, but it does so immersed in that work context significant for him, assimilating, appropriating and systematising the organisational culture of the companies and the work experiences accumulated in them. In addition to the obvious relationship between the learner and the company with which he or she is trained, relationships are created between the teacher and the company, between the educational center and the productive entity, between the teaching process and the productive process, and between academic education and professional training.

To achieve the learning of professional skills, Project-Based Learning is especially useful as it introduces the student to a realistic project [10, 18]. If in addition, this project is performed with the collaboration of a real organisation, the project in addition to being realistic is also real, and you get the development of professional skills of which we spoke.

## 2.5 Service Learning

There are several points of view when defining the Service Learning concept. Some approaches emphasise the roles of faculty and community members in the process, and others make social justice or systems change an explicit objective [19].

The Corporation for National and Community Service emphasises the fact that with this type of learning, students develop through active participation in experiences that meet the real needs of the community. These experiences need to be integrated into the students' academic curriculum and provide structured time for reflection. In this way learning goes beyond the classroom and extends into the community [20].

An important nuance that distinguishes Service Learning from other types of experiential learning (school volunteering, community service, field activities or internships) is the fact that there must be reciprocal benefits, i.e. Service Learning only occurs when there is a balance between learning objectives and service outcomes. In short, in true Service Learning the results of the experience must benefit both the service provider (the student and the educational institution) and the receiver (the social organisation) and the two facets of the process (as a learning process for the student and as a service for the organisation) must be balanced [19, 21, 22].

This is our approach in this work. We are interested in a reciprocal Service Learning, since the first goal is using a project to make the students learn, but this project is performed for a social organisation which is, in turn, interested in receiving a final product. Moreover, there is a third facet in Service Learning: in addition to the acquisition of the specific technical skills of each degree, this methodology (complemented with PBL) also reinforces the training of the transversal skills that all students must develop in order to be good professionals: critical and reflective thinking, decision making, teamwork, communication and negotiation, problem solving and initiative. This way, the possibilities of labor insertion are multiplied, as these skills are among the most demanded by employers.

### 3 Context

Originally, the master's programme was designed as a face-to-face course. Subsequently, the course became a blended-learning course [23], so the subjects had to be modified to include a part of non-classroom work with a significant workload. In this section we explain how the subjects were after their transformation to become blended-learning, but before the experience presented here.

The two subjects that take part in this experience are *Strategic Direction of Information Technologies* and *Applied Technological Innovation*. Both are compulsory first-year subjects, taught in the first semester, and their design is based on the principles of *teaching by example* (for the teacher) and *learning by doing* (for students). For this reason, the principles and techniques specific to each discipline (management skills and instruments for direction and innovation) as well as the principles and diversity of teaching innovation tools were taken into account. Thus, the subjects were made up of different pieces fitted together making a puzzle, and with the evaluation as the backbone of the teaching proposal, indicating to the students the path to follow.

The fundamental blocks of the design, applying the principle of task-centred learning, are:



- Lessons: devoted to expose the theoretical contents of the subject.
- Workshops: devoted to organise a hands-on session about specific techniques or methods.
- Deliverables: that students must hand over in order to success the subject and fulfill the learning outcomes.

Following the philosophy of Flipped Learning, the classroom hours were invested in the tasks that best took advantage of the interaction, both between the teacher and the students and between the students themselves. And the student's autonomous work consisted of preparing for the face-to-face sessions: watching videos, reading documents, searching information, interpreting infographics and figures or navigating through websites.

For the evaluation of the students' learning, different instruments depending on the subject were used as a cocktail, which made it possible to measure the students' learning from different perspectives. In addition, in the last session the subject and the teacher were evaluated by means of a satisfaction survey.

This modular and task-based design has allowed us to evolve the subjects throughout the seven academic years that they have been teaching and make the coupling between both subjects and the adaptation to the Spanish Red Cross organisation in a simpler way. In the following sections, we present each of the subjects in more detail.

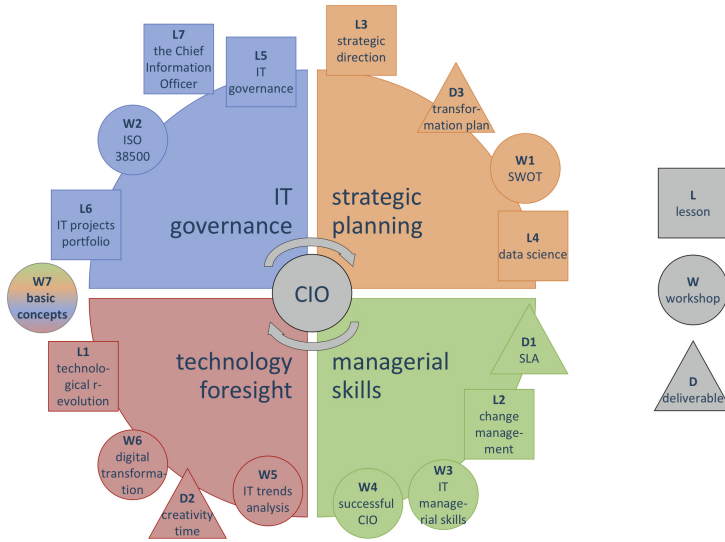
### 3.1 Strategic Direction of Information Technologies

The subject is organised in four main blocks: IT governance, Technology foresight, Managerial skills and Strategic planning, with the CIO (Chief Information Officer) as the centre of the subject. The task-based approach allows the students to acquire the knowledge corresponding to one or several of the four blocks of the subject through the performance of these tasks. In addition, they develop different skills, depending on the type of task (lesson, workshop or deliverable). Figure 1 presents in a schematic way the structure of the course and the different tasks proposed.

A key element was introduced in the course: learning minutes. They ensured the proper organisation of all this educational architecture and helped the students to be aware of what they were doing at each moment and what they had yet to do. A more detailed description of the design of the subject can be consulted in [24].

The evaluation of the students' learning has been carried out through different instruments (questionnaires, conceptual map, practical work, participation and preparation of workshops, oral presentation of the works, defence of an IT trend...) in order to have a multifaceted vision of the students' learning results. Throughout the course, at the end of each activity (a whole block) there was a brief debate about the positive and negative aspects of the activity.

Satisfaction surveys carried out at the end of each year show that the students, in a time sustained manner, have valued the subject very positively. In terms of content, they essentially report that this model has allowed them to



**Fig. 1.** Structure of *Strategic Direction of Information Technologies*

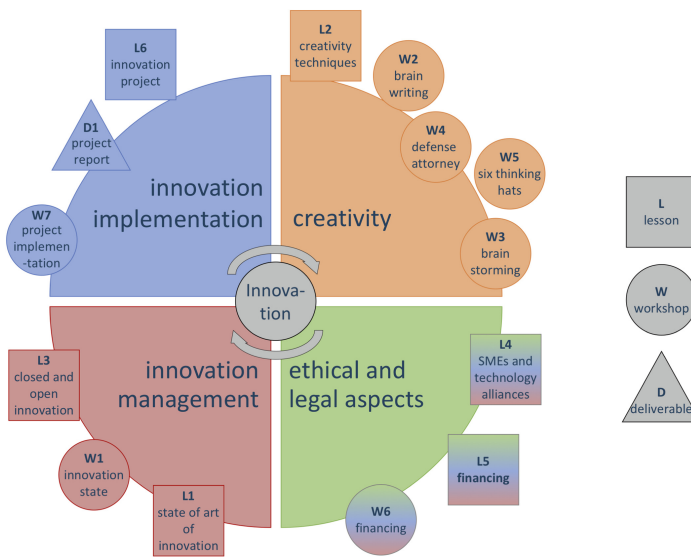
do more research on the subjects as well as helping them to delve deeper into certain concepts. And as relevant aspects, they say that it is good to spend time studying at home and debating in class and that the blended-learning model has helped them to combine studies with work.

### 3.2 Applied Technological Innovation

Since its inception, the subject has introduced Project-Based Learning as a differentiating element. Therefore, the main objective of the subject is to acquire knowledge, skills and abilities in a proactive way, carrying out an innovation project from its conception, covering the different stages necessary for its correct design and implementation.

The subject can be divided into four main thematic blocks (Fig. 2): Creativity, Innovation Management, Innovation Implementation, and Ethical and Legal Aspects. In some of the didactic units these aspects are seen from more than one perspective. Specifically, the units dealing with the issues of SMEs, Technology Alliances and Financing are seen from an innovation management approach (through case studies, trends and possible improvements), from an innovation implementation approach (how the specific project can be financed, or which is the best alliance to carry it out) and from an ethical and legal approach (defining the legal requirements and social responsibility aspects that must be considered to carry out and implement the project in question).

The subject begins with sessions in which the origins of innovation are evaluated and workshops are held to generate, defend and evaluate ideas, already



**Fig. 2.** Structure of *Applied Technological Innovation*

focusing on a specific project. The tasks of the students in the successive sessions are:

- Define the objectives and value proposition of their project, its strengths and weaknesses, as well as the innovation it represents for society.
- Describe in detail the whole project, evaluate the risk management and study the impact it would have, both at the innovation level, as well as at the ethical and social level.
- Present a plan for dissemination and exploitation of the project.
- Detail the estimated budget for the implementation of the project.
- Specify the most appropriate financing plan for the project, weighing the different types of public and private financing.
- Search for possible alliances that would be convenient for the real implementation of the project.

At the end of the term, the project is fully defined and only its implementation and real deployment are missing, aspects that are beyond the scope of our subject.

The evaluation of the subject is made from small deliveries that must be made during the course and, mainly, from the project. The project is assessed by teachers and by peer evaluation. The aspects that are assessed are: the communication capacity of the team, the technical quality of the project, the innovation it implies, the viability of the project and the quality of the presentation, in such a way that both specific and transversal skills are evaluated.

## 4 Proposal

The Master in Computer Engineering [6] trains future technology directors, in contrast to the Bachelors degrees and other Masters degrees that basically train technicians. These professionals must have a broad scientific, technological and socioeconomic training that allows them to direct and manage development and application projects in the field of Computer Science. To this end, the degree has, among others, objectives such as training for strategic planning; management and coordination of multidisciplinary teams; technical and economic management of projects; research, development and innovation projects; human resource management and application of ethical responsibility, legislation and professional ethics.

In this demanding environment of professionals with high management skills, it was not appropriate to develop the subjects in the traditional way. For this reason, this proposal was put forward as a result of the needs identified.

The starting point is the need to transversalise learning. That is why we started with a collaboration between two subjects. In classical teaching, knowledge has always been fragmented, in the form of subjects. Each subject focuses on its own content and rarely communicating vessels between subjects are considered. However, the reality is that the real problems are not compartmentalised. Problems do not belong to a single subject. Our students, particularly at the level of Master, really know how to solve problems when they are able to integrate the knowledge of the different disciplines. The two subjects chosen develop the aspects of strategy and innovation that are indeed the two highest level elements in organisations.

The second element is the decision to articulate the learning around a project, due to the success of this methodology in the separate subjects and in some previous experiences of the teachers in other subjects [8–10]. This way, learning is based on *learning by doing* in which skills, attitudes and knowledge are acquired as a consequence of action. This methodology fosters skills such as autonomous learning and work, self-evaluation and self-criticism, time planning, leadership, oral and written expression skills, and so on. Moreover, the project is tackled as a team, which allows, in addition, to acquire other transversal skills related to group work, preparing the students for a social environment. The final consequence is that the PBL improves student performance and motivation.

The third element we introduced into the equation was the use of a real case to setup the project. Academic projects that are often used in the PBL are often far from the reality of actual organisations. This means that the conditions for project development are artificial and very controlled. In a real environment the requirements tend to be much stricter and the situation much more uncertain. The introduction of a real organisation has allowed us to develop a Professional Learning, i.e., subject to the rules, the time and economic constraints, and the uncertainty of a real professional environment.

Finally, we decided that the organisation that hosted our course should be a non-profit institution with a social character. This has allowed us to approach the learning process as Service Learning, so that the project resulting from the

subject had a double objective: to serve as learning for the students but also to serve as a service to a third party and to society in general. On the other hand, the fact of introducing students into a social environment, with interdisciplinary teams made up of technologists and social agents, reinforces transversality, the need to look for solutions in contexts very different from the usual ones and learning in CSR matters.

Figure 3 presents the structure of the learning proposal. The project is the centre of the process and involves both subjects and the organisation being studied. In the following sections a deeper explanation of the proposal is presented.



**Fig. 3.** Structure of *Four Dimensional Learning*

### 4.1 Project

The project becomes the centre of learning and the main deliverable of both subjects. Although the project is unique, it develops the contents of both subjects in two distinct parts:

- The Digital Transformation Plan: it is nourished by the different workshops of *Strategic Direction of Information Technologies* subject, in which an in-depth analysis of the organisation is carried out in order to identify strengths, weaknesses, opportunities and threats and generate the SWOT analysis. This analysis continues with the definition of objectives and actions to define the strategy of the organisation. The identification of the main IT trends and the development of managerial skills also contribute to the definition of the Digital Transformation Plan.
- The Innovation Project: The Spanish Red Cross defines a problem and the students frame it within the organisation's strategies. From there they identify a possible solution based on technology and propose an Innovation Project to develop that solution. The Innovation Project is developed in several stages in the subject *Applied Technological Innovation*, articulated in the form of workshops: creativity and generation of ideas, financing, alliances, and so on.

In this way the following objectives are achieved thanks to the project:

- The project enables a complete analysis of the organisation.
- The project allows the identification of strategic actions in the field of IT.
- The project provides an innovative technological solution aligned with one or more of the identified strategic actions.

## 4.2 Coordination

It is essential that the project is conceived as a single project with its own entity, even if it is developed in several parts. This requires a complete coordination between the people involved (teachers and people in charge of the external organisation) and between the contents of the subjects. To this end, the following coordination mechanisms are established:

- Temporal and spatial coordination: the face-to-face sessions of the subjects have been concentrated in a single day and in the same space, facilitating plenary sessions and visits to the offices of the external organisation. This coordination may seem minor, but it is very important because it eliminates much of the logistical problems that existed when this was not fulfilled.
- Methodologies and content coordination: the different types of learning activities have been homogenised, with only three types of activities, as previously mentioned: lessons (generally developed outside the classroom through readings, videos, websites...), workshops (generally developed in the classroom, in teams, drawing up minutes of what is done and agreed upon) and deliverables (products that are developed in teams or individually, mostly carried out outside classroom hours).
- Tools coordination: beyond the tools specific to each activity, the same Learning Management System is used to make the materials available to the students, as well as the same tools for collaborative work.
- Teacher coordination: the teachers meet weekly for the joint follow-up of the course development. In many cases, all teachers attend the same work session (this always happens in plenary sessions).

- Organisation coordination: teachers and the heads of the external organisation have several previous work sessions to define the objectives of the projects for each academic year, to determine the departments of the organisation that will participate in that course, and to agree on the dates of the plenary sessions.
- Evaluation coordination: the evaluation of the project is joint, which implies in itself a coordination mechanism between the subjects. The evaluation is discussed in more detail in a later section of this article.

### 4.3 Sessions

The course is developed over 15 weekly sessions of 8 h, of which 4 are non-classroom work and 4 are face-to-face work. The non-classroom work is perfectly scheduled and consists mainly of lessons and the development of deliverables, while the face-to-face sessions focus on teamwork in the form of workshops most of the time. Moreover, the face-to-face sessions of the subjects are of two types: plenary and ordinary.

The plenary sessions are joint sessions of both subjects in which all the students participate (as they are independent subjects, there may be some students enrolled in only one of them, although this is a very infrequent case), all the teachers and the heads of the Spanish Red Cross. Although 4 h are available, they last between 2 and 3 h, depending on the number of projects developed. There are three plenary sessions throughout the course:

- Initial plenary session: It is a session of presentation of the subjects and of the organisation. It is usually organised in a classroom at the University of Alicante, in the first week, to which the Spanish Red Cross leaders are invited. In this session the subjects are presented and an overview of the organisation is given. In addition, a specific problem is presented, that students must specify and frame in a strategic line within their Digital Transformation Plan. In addition, this problem will serve as the basis for the Innovation Project, in which they must find a technological solution.
- Intermediate plenary session: Before the end of the first half of the course (towards the sixth or seventh week), a working session is organised at the headquarters of the external organisation. At this time, the plans for Digital Transformation and the Innovation Projects are outlined, but not specified. It is time to resolve the doubts with the organisation. In addition, this session serves to get to know the organisation and its headquarters, with the presence of the heads of the different departments that give a complete view of the Spanish Red Cross.
- Final plenary session: The last session of the course consists of the presentation of the projects and of their evaluation. The session takes place at the Spanish Red Cross headquarters. The presentation allows the development of communication skills and the joint presentation of the results of all the work of the term. Doing so at the organisation's office provides a professional framework, facilitates the assistance of the members of the Spanish Red Cross,

gives it an institutional character and facilitates that the project is seen as a service for this institution. The evaluation of the project is carried out by peers and with the participation of the teachers and the organisation's heads. In a later section we delve into the evaluation issue.

The ordinary sessions last 4 h (2h dedicated to each subject) and basically the workshops proposed in each subject are developed, as previously mentioned. Some of these workshops include the participation of members of the Spanish Red Cross. Sometimes these persons travel to the classrooms of the University of Alicante, other times are the students who move the offices of the organisation and most times the communication is established through videoconference.

The sessions of the first half of the course (between the initial and the intermediate plenary sessions) are aimed at developing basic skills, getting to know the organisation in general, and generating ideas that will allow the development of an innovative solution to the proposed problem. As a result, the intermediate plenary session is reached with an outline of the Digital Transformation Plan and two or three alternative solutions for the Innovation Project. The intermediate plenary session allows to solve doubts and prepare for the final development of the project.

After the intermediate plenary session, the first version of the Digital Transformation Plan has been validated and the Innovation Project has identified the criteria that allow defining a specific solution. From then on, and until the end of the course, the ordinary sessions are dedicated to the complete development of the project, deepening its contents and resolving punctually the problems that arise directly with the Spanish Red Cross in specific work meetings.

#### **4.4 Participation of the External Organisation**

The participation of an external organisation and its involvement in the learning process is fundamental to the success of such an experience. The organisation has three fundamental roles in the process: it is the organisation being studied, so it must be willing to share internal information that allows students to know it in depth; it is the service beneficiary, so it must be able to provide a problem that is strategic or at least of high interest to it; and it is the center of the development of the project, so it must be willing to meet the needs of the students, participating in the different work sessions.

A committed participation of the organisation has a high impact on the four dimensions of learning that we have proposed. In this sense, the participation of the Spanish Red Cross has been fully satisfactory.

#### **4.5 Evaluation**

Each subject is evaluated through different instruments such as questionnaires, participation in class, short oral presentations, occasional deliveries and, of course, the whole project. The aim is obtaining a multifaceted vision of the students' learning results.



In the evaluation result, the main facet is, however, the project, in accordance with the time devoted to its design and development. The project is assessed by the students (peer evaluation), by the teachers and by the member of the Spanish Red Cross.

The evaluation is carried out at the end of the course, in the final plenary session, through a rubric, which is identical for all evaluators. The rubric assesses the following aspects:

- Communication capacity of the team and quality of the presentation
- Team work and collaboration
- Quality of the strategical analysis of the organisation
- Quality of the innovative solution and its impact
- Technical quality of the project and its implementation
- Ethical and legal aspects
- Viability of the project, budget and financing.

Each aspect is evaluated at four possible levels:

1. Deficient
2. Enough
3. Good
4. Excellent

In addition, evaluators are asked to highlight the strengths and weaknesses of the project and to offer their opinion freely.

#### **4.6 Satisfaction and Opinions**

At the end of the term, the opinion of the students and the Spanish Red Cross heads is gathered through a questionnaire. The following are the most generalised opinions regarding the learning model presented here.

The students value in a very positive way the dynamics of the subjects and the project development within a real and social organisation. Their specific opinions are focused on highlighting the following aspects:

- The project seems to them to be a perfect tool to practice all the aspects studied in the subjects.
- The study of real cases is an attractive way for them to learn about the contents of the subjects and to project them into the world of work.
- This way of working gives them new knowledge in order to approach their professional projects from a different perspective. Thus, they perceive that these subjects will be useful in the future.

From the Spanish Red Cross organisation, the people who collaborate in these projects perceive very positively the way in which the students get involved in a facet, the social scope, so foreign to the technological field. The comments that they suggest to us after the experience can be summarised in:

- They are attractive projects with a good technological solution.

- They are very innovative projects.
- The projects involve large collectives that the organisation deals with, so they can be very useful for them and give practical solutions to some of their problems.
- The impact that projects would have on society is very positively valued.

## 5 Conclusions

We have presented an approach called Four-Dimensional Learning, based on the following four dimensions:

- Project-based learning: The project becomes the central component of the learning process. We adopt the PBL as the central element, and the other three dimensions of learning contribute to improving the project and the own learning, as we want to represent in Fig. 3.
- Professional Learning: The project is based on a real case, but not only that, the students have a direct contact with the organization: they know what is their daily life, what are their real needs and particularities of the organization (their priorities are probably different from those of a business, so they can compare it with other examples they see throughout the degree).
- Transversal learning: The project is seen as a whole. Not only must a problem be solved, but it is necessary that the project is framed in the strategy of the organization. In this way they learn to satisfy the requirements of several parts: the subjects (on the one hand, the strategy and on the other, the innovation) and the organization itself.
- Service learning: The result of the project becomes a service to the organization and, by extension, to society.

This approach makes it possible to develop several facets of a technology manager in an organization:

- The role of the CIO, knowing all the aspects of the organization and taking part in its governance. Its role, therefore, is to identify strategic actions of the organization in the field of technology, always aligned with the rest of the organization.
- The role as the person responsible for innovation, knowing how to conceive an innovation project (for this reason special attention is paid to the development of creativity) and how to manage it (at a more technical level).
- The role as the person in charge of prospecting, to identify new technologies that allow solving the organization's problems.

In addition, all this proposal contributes to developing a learning imbued with social responsibility. This theme is not only a set of explicit lessons, but is implicit in all learning. In this way, the need to attend to the social responsibility of future engineers is much more set, as the students have faced the problem in a real case and in a professional environment.

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