Chapter 2

Integrative Learning Toward Social Responsibility in Teaching Engineering: “Sustainable Development Goals: Quality Education”

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ABSTRACT

The Technical University of Madrid, within the Spanish context, has profited from the introduction of a System of Internal Quality Assurance to build a road on the grounds of previous work on the culture of ethics in engineering. This way may drive the students training to incorporate in their curricula, leadership instruments that can be used for the recognition and acquisition of social responsibility. The road is paved with various educational elements, either mandatory, such as the “Mentoring Project” (peer support program), or optional, such as “Monitoring” (peer academic support program), “Ethics and Values in Engineering” (with social entrepreneurship projects) and “Service-Learning” (methodology that combines learning objectives with community service). This strategy, combined with the convergence

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of the European Higher Education Area, allows selecting those students who are able to integrate in their professional assets the idea and commitment of making the human development more sustainable, since the named experiences work towards the Sustainable Development Goals.

INTRODUCTION

The chapter describes a process of integrative learning in teaching engineering on ethical dimensions to attain social responsibility of the trainees. This experience has been carried out in the School of Mining and Energy of the Technical University of Madrid (ETSIME-UPM).

The chapter narrative delineates the trajectory followed in the ETSIME-UPM to achieve an integrative learning process. It begins with a short review of the introduction of the system of quality and accreditation in Europe. It is followed by work carried out at ETSIME-UPM by incorporating the teaching of Ethics and Values, a process which has driven to the incorporation of social innovation, social entrepreneurship and service-learning as applied instruments of the ethics field. A first appraisal of the results of these interventions is presented.

The initiative undertaken by ETSIME-UPM more than a decade ago was originally aimed at following the model of the USA institutions. However the evolution of the teaching ethics program in the ETSIME-UPM under the Spanish context revealed the need to introduce changes from the model along the path. The initial proposal was turned out into the integrative learning toward social responsibility for introducing in teaching engineering as illustrated in this chapter and in its previous version (Martín-Sánchez et al., 2016)

The ETSIME-UPM approaches the Sustainable Development Goals (SDGs) proposed for 2030, through the quality assurance in the universities (EHEA) that is articulated through the System of Internal Quality Assurance (SIQA). These systems are validated by different national, European and global agencies, through the achievement of different criteria, among which are the ethical and social criteria that are developed in the activities and itineraries proposed in this article. On the one hand, the SDGs that are mainly worked are Number 4: Quality Education and Number 17: Partnerships for the goals. On the other hand, those related to sustainability and climate also have a significant impact on the activities of the ETSIME-UPM.

BACKGROUND

The reflection on how to build the ETSIME-UPM strategy started by looking at the milieu conditions and the essential role played by the System of Internal Quality Assurance (SIQA) under the framework of the European Higher Education Area (EHEA). The axes underlining the evolutionary process of Bologna (1999) since the Sorbonne Declaration (1998) to London declaration (2007) were aimed at assuming a common strategy for attaining the goal of cooperation and guaranteeing the quality of the

process. This strategy was assigned in the London meeting (2007) to the so called Group E4. Under such strategies designed for accreditation in the EHEA, it seems of particular relevance the launching and establishment of a European Register - following the indications of the meeting at Bergen (2005) - of the different organizations for accreditation and SIQA, which may fulfill a series of the demands required.

In 2012, a review of The Standards and Guidelines for Quality Assurance in the EHEA adopted in Bergen (ESG) was carried out “to improve their clarity, applicability and usefulness, including their scope”. This revision is reflected in the 2015 version of the ESG, where the standards for quality assurance have been divided into three parts:

- Standards and guidelines for internal quality assurance
- Standards and guidelines for external quality assurance
- Standards and guidelines for quality assurance agencies (European Association for Quality in Higher Education, n.d. (a))

After consulting the existing bibliography, a table (Table 1) has been drawn up showing the different political milestones related to higher education, highlighting mainly two topics: Quality assurance and social dimension

Through this table 1 you can see the direct relationship that both topics have, as well as the concern on the part of the ministers to implement them. From our point of view with this table there is clear evidence between both aspects that are currently not related in the literature and that are absolutely topical. This situation has led us to deepen a study that we had previously raised in this publication.

ASSOCIATIONS AND AGENCIES FOR QUALITY

The mission of the European Association for Quality Assurance in Higher Education (ENQA) is to drive the development of quality assurance by representing agencies internationally, supporting them nationally, and providing them with comprehensive services and networking opportunities. ENQA promotes the enhancement of quality and the development of a quality culture in higher education (ENQA, n.d. (b)).

Full Membership of ENQA is composed of European quality assurance agencies or other quality assurance organizations of 30 countries in the field of higher education that have been operating and conducting actual quality assurance activities in recent years. (ENQA, n.d. (c))

The Spanish Case

Spain is represented in ENQA by the **National Agency for Quality Assessment and Accreditation of Spain** (ANECA) and ten regional agencies from the corresponding Autonomous Regions. ANECA is the body for evaluating the quality of higher education at the national level responsible for carrying out assessment, certification and accreditation activities of the Spanish university system with the aim of its continuous improvement and adaptation to the EHEA. (ANECA, 2002.)

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Table 1. Ministerial declarations and communiqués. quality assurance and social dimension in higher education.

Ministerial Conferences	Quality Assurance in Higher Education	Social Dimension in Higher Education
Berlin Conference (2003)	The quality of higher education has proven to be at the heart of the setting up of a European Higher Education Area. Ministers commit themselves to supporting further development of quality assurance at institutional, national and European level. They stress the need to develop mutually shared criteria and methodologies on quality assurance.	Ministers reaffirm the importance of the social dimension of the Bologna Process. The need to increase competitiveness must be balanced with the objective of improving the social characteristics of the EHEA, aiming at strengthening social cohesion and reducing social and gender inequalities both at national and at European level.
Bergen (2005)	Almost all countries have made provision for a quality assurance system based on the criteria set out in the Berlin Communiqué and with a high degree of cooperation and networking. We adopt the standards and guidelines for quality assurance in the European Higher Education Area as proposed by ENQA. ESG: The Standards and Guidelines for Quality Assurance in the EHEA adopted in Bergen	“We renew our commitment to making quality higher education equally accessible to all, and stress the need for appropriate conditions for students so that they can complete their studies without obstacles related to their social and economic background”.
London (2007)	“The first European Quality Assurance Forum, jointly organised by EUA, ENQA, EURASHE and ESIB (the E4 Group) in 2006 provided an opportunity to discuss European developments in quality assurance”.	“Higher education should play a strong role in fostering social cohesion, reducing inequalities and raising the level of knowledge, skills and competences in society”.
Leuven and Louvain-la-Neuve (2009)	“We have also seen the creation of a European register for quality assurance agencies and the establishment of national qualifications frameworks linked to the overarching European Higher Education Area framework, based on learning outcomes and workload”.	Equitable access and completion. We therefore emphasize the social characteristics of higher education and aim to provide equal opportunities to quality education. Efforts to achieve equity in higher education should be complemented by actions in other parts of the educational system.
Budapest-Vienna (2010)	“While much has been achieved in implementing the Bologna reforms, the reports also illustrate that EHEA action lines such as degree and curriculum reform, quality assurance, recognition, mobility and the social dimension are implemented to varying degrees”.	We are convinced that higher education is a major driver for social and economic development and for innovation in an increasingly knowledge-driven world. We shall therefore increase our efforts on the social dimension in order to provide equal opportunities to quality education, paying particular attention to underrepresented groups.
Bucharest Communiqué (2012)	We will revise the ESG to improve their clarity, applicability and usefulness, including their scope. The revision will be based upon an initial proposal to be prepared by the E4 in cooperation with Education International, BUSINESSEUROPE and the European Quality Assurance Register for Higher Education (EQAR), which will be submitted to the Bologna Follow-Up Group.	“The student body entering and graduating from higher education institutions should reflect the diversity of Europe’s populations”
Yerevan Communiqué (2015)	“Enhancing the quality and relevance of learning and teaching is the main mission of the EHEA. Policy measures adopted: the revised Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG)”	“Making our systems more inclusive is an essential aim for the EHEA as our populations become more and more diversified, also due to immigration and demographic changes”.
Paris Communiqué (2018)	In order to encourage the development of more joint programmes and joint degrees, we will also enable and promote the use of the “European Approach for Quality Assurance of Joint Programmes” in our higher education systems. We welcome and will promote the development of the Database of External Quality Assurance Results (DEQAR).	...further effort is required to strengthen the social dimension of higher education. In order to meet our commitment that the student body entering and graduating from European higher education institutions should reflect the diversity of Europe’s populations, we will improve access and completion by under-represented and vulnerable groups. Therefore, we mandate the Bologna Follow-Up Group to take this issue forward by the next EHEA Ministerial conference.

Source: Compiled from the website of the European Higher Education Area. EHEA (n.d.)

Quality Certificate for Engineering Studies: European and American case

- The EUR-ACE label is a certificate given by an authorized agency by the European Network for the Accreditation of Engineering Education (ENAE) to a university with regard to an engineering degree or master that has been evaluated according to a series of defined standards in agreement with the following principles: quality, relevance, transparency, recognition, and mobil-

ity as referred in the EHEA. In Spain this EUR-ACE label is awarded by ANECA through the “ACREDITA PLUS” program in collaboration with the Professional Associations of Engineers.

- **ABET Accreditation Board for Engineering and Technology, Inc.** ABET (n.d.) is a nonprofit, non-governmental organization recognized by the Council for Higher Education Accreditation (CHEA). ABET is recognized as the worldwide leader in assuring quality and stimulating innovation in applied science, computing, engineering, and engineering technology education. ABET accredits the quality of university programs in engineering. The most prestigious universities, such as MIT, Harvard or Stanford have also been awarded this ABET accreditation. It certifies the quality of qualifications in response to the requirements of the major professional engineering associations worldwide.

The European accreditation system is validated by professional associations through a quality agency. While the American accreditation system is a particular agency. Below you can see a figure (Figure 1) where a comparison of the different quality criteria of European and American accreditation appears

SYSTEMS OF INTERNAL QUALITY ASSURANCE IN SPANISH UNIVERSITIES

This analysis stems from the context of a Spanish case, and is rooted in the teaching programs of an institution of higher education, the ETSIME-UPM but the intention is to spread and debate it internationally.

This chapter arises from a **System of Internal Quality Assurance (SIQA)**, which has to be adopted by each Educational Center with the aim of advising the governing bodies of each institution. This system of quality management based on continuous improvement is directed to enforce a coherent and aligned policy with the quality ideals of the Center.

Figure 1. Comparison of quality criteria between European and American agencies

EUR-ACE CRITERIA			ABET CRITERIA			
1	Needs, objectives and outcomes	1.1 Needs of the interested parties	~	Criterion 1: Students	Criterion 6: Faculty	Criterion 8: Support
		1.2 Educational Objectives	~	Criterion 2: Program Educ Objectives	Criterion 4: Continuous improvement	
		1.3 Programme outcomes	~	Criterion 3: Program Outcomes		
2	Educational Process	2.1 Planning	~	Criterion 5: Curriculum	Criterion 3: Program Outcomes	
		2.2 Delivery	~	Criterion 5: Curriculum	Criterion 1: Students	Criterion 3: Program Outcomes
		2.3 Learning Assessment	~	Criterion 5: Curriculum	Criterion 1: Students	Criterion 3: Program Outcomes
3	Resources and partnerships	3.1 Academic and support staff	~	Criterion 6: Faculty	Criterion 8: Support	
		3.2 Facilities	~	Criterion 7: Facilities		
		3.3 Financial Resources	~	Criterion 8: Support		
		3.4 Partnerships	~	Criterion 8: Support		
4	Assessment of Educational Process	4.1 Students	~	Criterion 1: Students	Criterion 3: Program Outcomes	Criterion 4: Continuous improvement
		4.2 Graduates	~	Criterion 1: Students	Criterion 4: Continuous improvement	
5	Management System	5.1 Organisation and decision-making processes	~	Criterion 8: Support	Criterion 4: Continuous improvement	Criterion 2: Program Educ Objectives
		5.2 Quality Assurance System	~	Criterion 8: Support	Criterion 2: Program Educational Objectives	

Needs, objectives and outcomes	Criterion 1: Students	D. Advising Students
Educational Process	Criterion 2: Program Educational Objectives	E. Transfer Students and Transfer Courses
Resources and partnerships	Criterion 3: Program Outcomes	A. Mission Statement
Assessment of Educational Process	Criterion 5: Curriculum	E. Process for Establishing Program Educational Objectives
Management System	Criterion 6: Faculty	E. Documentation: Describe by example how the evaluation team will be able to relate the display materials
	Criterion 7: Facilities	B. Prerequisite Flow Chart
	Criterion 8: Support	C. Course Syllabi
		D. Faculty Competencies and how they are adequate to cover all of the curricular areas of the program
		F. Faculty: abbreviated resume for each program faculty member
		F. Faculty Development: plan for faculty development and the funding available
		C. Major Instructional and Laboratory Equipment: list
		D. Support of Faculty Professional Development
		E. Support of Facilities and Equipment
		F. Adequacy of Support Personnel and Institutional Services

Source: own elaboration

As a secondary purpose, the implementation and maintenance of the processes necessary for the development of such a SIQA is worthy of mention. This system will determine the main priorities for improving teaching, research and management activities by gathering information, as well as by promoting studies or surveys to measure the effectiveness of the implemented activities.

Once these premises have been established, an analysis of the basic elements that will support actions may proceed, and these premises may raise essential issues to be addressed. At this point the Educational Center is able to define to society and stakeholders what will be its mission, which will be the institutional values to be conveyed, and what might be the strategic foresight to raise essential issues.

Taking the aforementioned strategy as a general framework, each and every University Center could then define the scope and educational offer that will meet the demands of society, not only through the transmission of knowledge, but also through demonstration of their commitment to social progress.

Engagement with training and professional development of the faculty members should be focused on an array of values. These values can be preserved by applying quality plans and including them in the design of the curricula. Generally speaking, these values are the following:

- Active respect for others, encouraging participation, trust, responsibility, cooperation, solidarity and joint action.
- Professional honesty.
- Freedom of ideas and beliefs.
- Defense of equal rights and opportunities.
- Contribution to scientific, economic, cultural and social development.
- Projection of the reputation of the Center and the University.
- Connection of the Center to its immediate surroundings.
- Transparency and accountability in management.

Taking into account these values, the objectives of the Spanish Educational Center, that is our case study, can be classified into three main groups:

1. Obtaining an **education of excellence**, whose purpose is to prepare students to become top professionals, with skills and capabilities to face continuous changes and advances in technology while meeting growing social demands.

In the ETSIME-UPM the SIQA is reinforced with the ethical and social component. These social skills are fundamental for all accreditation systems (internal, national and international) accreditations. The development of these competences through the activities that will be described in detail later, allow the UESEVI to be consistent with the objectives set for Europe2020, and of course with the 2030 Agenda for Sustainable Development.

Quality Education is the objective 4 of the sustainable development objectives and is present in all our activities, more specifically goal 4.7. which says the following:

By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development. (ONU, n.d.)

2. Supporting the **scientific and technical development** by applying research projects to respond to the demands of different industrial sectors. Those demands should be primarily defined through a close relationship with firms and other involved shareholders.
3. Promoting the **continuous improvement of the Center** in order to assess its human resources, material resources and services. Through the establishment of a Quality System with a performance record within **the process of guaranteeing the quality of a Center**, the stakeholders must be clearly identified and join around common goals. It could be assumed by each University that these stakeholders are: students, Administration and Service staff, Teaching and Research staff, Companies and Suppliers. It is also important to identify the **responsible actors** in charge of managing the information flows to and from the stakeholders, amongst which are the members of **the management teams, commissions and different government** bodies. Finally, it is essential to have supporting agents that will strengthen the lines of defense. For this purpose, foundations, Advisory Boards and University-Enterprise Units usually provide high quality results.

In brief, a SIQA can be defined as the ensemble of the interrelated Center elements, through which the Center is managed in a planned manner in order to pursuit satisfaction and continuous improvement of the service offered.

This system must be supplemented by a number of additional documents such as **procedures, records and information systems**. At the first level the compliance with the requirements contained in the proposal for getting the accreditation must be ensured. The application for the syllabus accreditation has to be submitted to the corresponding assessment agencies.

SIQA design may be based on higher level proposals, and thus more demanding. These proposals are defined below. In any case, these procedures will facilitate the verification of future college degrees, since the SIQA serves the regulatory requirements for authorization and registration of Degree and Master.

In Spain the “quality” of a University Center should have three levels of depth to ensure full integration of all procedures.

- The first level sets quality according to national standards aimed to ensure a minimum level within our education system. It concerns mainly the processes proposed by the Center, but it also allows certain impact on the educational process (e.g. ANECA and VERIFICA).
- The second level implies an increase in quality and has a national approach. At this stage an array of skills and fundamental processes have to be considered. (E.g. ACREDITA PLUS and AUDIT).
- The third level is addressed to the international accreditation and implies the effort of University to reach a state of excellence that guarantees its quality at all levels (e.g. EUR-ACE and ABET).

The different academic qualifications, recorded in the VERIFICA statements, define a set of specific and generic (or transversal) competencies that have to be achieved by graduates at the end of their studies. From this approach, the easiest way to achieve the goal is to start with the first level developing those skills in classroom. Following the verification process, the acquired skills are verified by the pertinent assessing body for Degree and Master.

DEVELOPMENT OF SOCIAL SKILLS THROUGH A SYSTEM OF INTERNAL QUALITY ASSURANCE

School of Mining and Energy-Technical University of Madrid

In order to cope with the **specific case of SIQA at the ETSIME-UPM**, the strategy established a set of guidelines to address the verification processes of the curricula with regard to the teaching and assessment of **specific and transversal skills**. Besides, a minimum of activities to promote the development of **social skills, connected to technical skills (specific)** was required as a practical procedure (or exercise).

The ETSIME-UPM assumes that those social skills go beyond the usual topics integrating the degree or the specific branch studies. Instead, students should also be trained in a range of skills and values that could enable them to behave as citizens committed to others and allowing their projection into the “common goods” that will conform the scenario of their professions (Environment and Society) (Martín & García-Laso, 2014).

Ethical Dimensions and Dynamics in the Teaching Program in Engineering

Introduction to the Teaching on Ethics and Values

Though the ethics issue is developed in the last section of the chapter, it must be pointed out that ethics has been the onset and the skeleton for building the road for allowing the integrative learning program to circulate into the academic curriculum at the ETSIME-UPM.

The study of ethics was introduced in the 2006-2007 period with the establishment of a Chair on Ethics and Values in Engineering funded by the FACT Foundation and thanks goes out to the strong bet on this initiative made by the Director of the School at that time.

Promotion of the Ethics Curriculum

The original idea was the promotion of the studies on ethics in engineering in an innovative and interdisciplinary way.

Due to the background in ethics of the Chair director, grounded on his dual career as an experimental scientist and a philosopher of science and technology, the program proposal was supported by blending the scientific method and the analytical reflection.

Along the phase of promotion, a process of research and analysis on the dimensions and dynamics of ethics took place, paying attention to what have been their main trends in the course of human development. The process started from the moral philosophy approach with reference to Aristotle and the Nichomachean Ethics (Aristotle, 2004), then went into the current professional ethics (deontology) and the social responsibility in corporations (Cortina, 2013) to finish with those movements focusing on the human relationship with nature and the concept of happiness as the utilitarian ethics pursues (Singer, 2002) or the ethics of responsibility as proposed by Hans Jonas works (1994). The academic and scientific, non-administrative, direction of the chair was assumed by Professor Muñoz Ruiz. The incorporation of Prof. Muñoz Ruiz, a former molecular and cellular biologist and strong supporter of the theory of evolution as a framework for ethics (Muñoz, 2015) has driven the teaching program at ETSIME-UPM to the field of social intelligence (Walker & Foley, 1973; Goleman, 2006).

The Educational and Experimental Frame

After the promotional phase, the course on ethics and Values in Engineering began under the framework of Science, Technology and Society studies (STS). The implementation of this logic implied that the lectures should be delivered by an interdisciplinary group and then, colleagues from the STS field, namely science philosophers, were invited to lecture.

Unlike the United States model programs for teaching ethics, we learnt from this experience that the educational dialogue between professors of philosophy and engineering students - even the motivated ones, as are in principle those attending our courses - is not easy. As a matter of fact, the Chair director had his own experience in the same direction, reaching the conclusions that the necessary theoretical topics had to be taught by wrapping them with practical references (social, political, in the media) to attract the student's interests and attention to gain satisfactory evaluation outcomes. Therefore, it was decided to focus the frame of the course on the consequentialist ethics inspired in the principles of responsibility, empathy and compromise, based on cost/benefit analysis in a wide sense not limiting it to the economic perspective, and being applied case by case. Moreover, this process has evolved to approach the ethics educational and experimental dynamics by using the concept of interethics or interrelated ethics of the different stakeholders involved (Muñoz Ruiz, Flor Ortiz, García Laso & Martín Sánchez, 2011; Muñoz Ruiz, García Laso & Martín Sánchez, 2018). After the reflection on the outlined issues, the frame of the teaching course in Ethics and Values in Engineering was revised by introducing changes in the staff of professors as well as in the topics being taught. According to the interethics concept, we have developed the ethical consequentialist approach resorting to the application of additional concepts such as those of science policy and governance in relation to science and technology, sustainability, and risk policies.

The Emergence of the Unit on Social Entrepreneurship, Ethics and Values in Engineering (UESEVI)

The transformation of the Chair into the Unit on Social Entrepreneurship, Ethics and Values in Engineering, referred usually as UESEVI, is the result of a series of institutional changes: in the directive staff of ETSIME-UPM with the arrival to this post of two professors related to this initiative; the loss of the initial funding support; the recognition that the move of ethics teaching to a more applied orientation could be an asset for a better integration of the students; and the strategic decision of the ETSIME-UPM directorate to incorporate the UESEVI activities into the Quality program of Mining.

The institutional reshaping contributed also to significant changes in the curriculum with the inclusion of new areas for thought and action such as Social Economy, Social Entrepreneurship and Service-Learning. New professors coming from economy and social entrepreneurship areas were invited to teach in order to provide insights into new visions and mission of the economic science and politics. Two of them have been selected by us as particularly relevant for the success of the UESEVI teaching program: a pioneer of Social Entrepreneurship in Spain, whose activities have been recognized by ASHOKA Spain (Drayton, 2006) and The Innovation Director & Founder at The Crew Concept where she is working in the link between creativity and innovation.

This new orientation provided an opportunity to detect the increasing interest of the students for the socio-economic impacts of the application of new visions of the ethical dimensions and dynamics we are engaged to teach and adopt as action rules for the future graduates in engineering. Following this, the frame of the Ethics and Values course was enriched by adding to the initial STS perspective

the concept of spaces. The spaces proposed to better comply with the UESEVI objectives were two: one blends Resources (natural, energy), Environment and Society to be integrated under the acronym REMAS, the other harmonizes Resources (natural, energy), and Environment and Economic impacts to be referred as REMARE.

The evolution along the decade of existence of the UESEVI teaching program on Ethics and Values in Engineering has allowed to increase the recognition of academic credit by the directorate of the Technical University of Madrid and has led to the proposal to develop a clear strategy for promoting the acquisition of transversal and horizontal skills.

Service-Learning (SL)

The service-learning represents the last section of the road that drives the engineering students towards an educational space rich in transversal skills and social compromises through the courses on ethics and values. This activity seems very relevant for the purposes of this publication since it embraces two of its goals: first, the need to stress the application to the professional life of the outcomes of a well-documented and innovative teaching process in ethics and values; second, the intention to contribute to the active involvement of the trainees in the multisectoral and interdisciplinary way of learning undertaken in ETSIME-UPM.

“Service-Learning is a course-based experiential learning strategy that engages students in meaningful and relevant service with a community partner while employing ongoing reflection to draw connections between the service and course content” (Service-Learning, n.d). The introduction of the service-learning as well as its dissemination in Spain is indebted to the pivotal role of Roser Batlle (2010). She has focused in the educational reform of the youths essentially at the first and middle levels and she declares: *“doing something good for the community, helping others, is also one of the most efficient methods of learning”*. The success of the promotional effort carried out by Batlle has led also to the establishment of a Spanish Network for Service-Learning that is extending its efforts to university education programs.

However, the academic and intellectual roots of the service-learning initiative were explored in retrospective. The term retrospective refers to the fact that the innovation specified by the service-learning initiative has been incorporated into UESEVI by an apparent reverse path to the logics of the academic world: it was first introduced as a practice following the lines designed and promoted by Batlle, then we were interested in delving into the historical and philosophical roots of this innovative educational instrument. The author of reference was John Dewey, already recognized as leader of the ethics intervention in education along the Ethics and Values part of the integrative system of teaching we are discussing (Dewey, 2001). This task has allowed us to identify that this way of uniting school success and social commitment is anchored in the seminal work of John Dewey, the leading proponent of the American school of thought known as “pragmatism”. Among the prominent influence of John Dewey in the field of educational reforms, we consider worthy to present some insights around his position in ethical and social theory. Enthusiast as he was of the Darwin evolution theory, we found significant intellectual convergences with the North American philosopher. In fact, in his social and ethical work, Dewey pointed out the need for an experimental approach which had to avoid the conservatism of the dogmatic approaches that inhibit the intelligent adaptation of human practice to the ineluctable changes in the physical and social environment. Ideals and values must be evaluated with respect to their consequences.

There are, in our opinion, underlying references to consequentialist ethics and even a preliminary evocation for the need to take into account the interrelationship between ethics (interethics). Therefore

these results are satisfactory by observing the links and convergences of the current teaching program with John Dewey previous thoughts together with the dynamics and dimensions that have evolved from his seminal intervention in the reform of the educational system.

On the other hand, on 1 January 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development officially came into force. Over the next fifteen years, with these new Goals that universally apply to all, countries will mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind. (United Nations, n.d.)

It is precisely the experiential character and its social dimension that make service-learning the ideal tool to work in the same direction as the SDGs. The idea of working with a formative activity that goes in the same direction as the SDGs, comes from the fact that they are the greatest challenge facing current generations. On this occasion, the difference between these challenges and other challenges that humanity has had to overcome throughout history lies in the fact that both the great economic and political powers are summoned, as well as all the organizations and individuals in our society.

By definition, Service-Learning carries intrinsically 2 of the 17 SDGs:

- 4. Quality Education, specifically the following target:
 - *4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development*
- 17. Partnerships for the goals, specifically the following targets:
 - *17.16 Enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries*
 - *17.17 Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships*

Moreover, as a further step in fostering the active intervention of the students, we selected the field diary (personal reflection written about the lived experience) as a useful instrument for assessing the evolution of the values acquisition and extraction of the trainees. From this exercise, we may conclude that the most relevant values recognized by the students after experiencing the service-learning experience are: collaboration, empathy, compromise and (social) justice.

The Involvement of the Trainees

The implication of the trainees during the Course on Ethics and Values in Engineering has been one of the main objectives of the teaching program since its inception.

The attainment of this objective has been achieved by providing the students with an evolutionary path in their studies. In the first part of the course, the more theoretical one, the students have been continuously asked to intervene in the dialogue atmosphere established from the beginning by the lecturers. Regarding the theoretical issues being dealt with in this first part, the trainees have been requested to go in depth by following the topics: Ethics and Values in Engineering; Environment and Society (Gov-

ernance, Sustainability and Social Space); Climate change; Prevention, Caution and Risk Management; Social Responsibility and Economy (Own and team values), Social Entrepreneurship and Innovation & creativity, as well as to delve into them thanks to other sources of information such as Google or in articles of some journals and newspapers also incorporated into the web of UESEVI.

The second half is addressed to introduce the students in practical instruments and interactive issues, such as social economy, social entrepreneurship, innovation and creativity in order to prepare them for the final goal of the course. This goal is the design, preparation, promotion and presentation of a project on Social Entrepreneurship, and therefore the demand for students to be active is even more imperative. Moreover, the students have to think about values, identify some of them and extract the most appreciated as a particular outcome of this period. During the process, the students have to cooperate working in teams and arriving to agreement on the topic and the instrumental organization of the Social Entrepreneurship Project (SEP). Together with the individual values that arises from the personal reflection, the process of SEP preparation impulses the emergence of collective values such as leadership, empathy and justice. Table 2 collects the SEP developed and presented by the students of the UESEVI program. All projects are related to some or some of the SDGs

A collateral aim of the process is the elaboration of a catalogue of values that may be classified in order of importance or preference leading to the outlining of what could be called “An ecosystem of values”.

On the other hand, taking into account the topics indicated above, the Sustainable Development Goals that are mainly worked on in this activity are the following:

- 4. Quality Education
- 5. Gender Equality
- 7. Affordable and clean energy
- 8. Decent work and economic growth
- 9. Industry, innovation and infrastructure
- 10. Reduced inequalities
- 11. Sustainable cities and communities
- 12. Responsible consumption and production
- 17. Partnerships for the goals

SOCIAL DIMENSIONS: THE UNIT FOR SOCIAL ENTREPRENEURSHIP, ETHICS AND VALUES IN ENGINEERING (UESEVI)

The convergence towards the EHEA has been a good opportunity to set, through SIQA procedures, the culture on Ethics and Values that had already existed in the ETSIME-UPM since 2006.

ETSIME-UPM involvement in the process of developing SIQA procedure has taken advantage of the strategy designed by UESEVI to enhance social learning through a program based on gathering of training practices on **Mentoring, Service-Learning** (i.e. practice of learning through experience *-practice field-* with the supportive service –volunteering-) and **Ethics and Values in Engineering** (social consciousness).

This has been carried out under the umbrella of specific consequentialist ethics, which has been developed and adopted to meet the vision and mission of UESEVI. The resulting applied ethics, named

Table 2. Social Entrepreneurship Projects presented by the students of the UESEVI program

Year	Title of the Social Entrepreneurship Projects	Social Objectives
2015-2016	<ul style="list-style-type: none"> •12 months, 12 foods •Exchange Project •The effectiveness of communication. Verbal and non-verbal language course 	<ul style="list-style-type: none"> •Food collection campaign (SDG2) •Assistance project for Erasmus students (SDG4) •Course to improve communication skills (SDG4)
2016-2017	<ul style="list-style-type: none"> •ETSIME-UPM App •School Support •Proposed implementation of CO and butane detector •Volunteering with children •Plugged 	<ul style="list-style-type: none"> •Mobile application with information for students and professors of ETSIME-UPM (SDG4) •Help with homework for children whose parents have low income. (SDG4) •Detector with CO and butane with low cost technology (arduino, raspberrypi) (SDG7) •Volunteers in children's hospitals to help with homework (SDG3, SDG4) •Plugs for all tables in the library of ETSIME-UPM (SDG4, SDG9)
2017-2018	<ul style="list-style-type: none"> •A more friendly, social and environmental school 	<ul style="list-style-type: none"> •Project to achieve a more connected and sustainable university (SDG5, SDG9)
2018-2019	<ul style="list-style-type: none"> •EcoMinas •SAVERGY •Digitization of the Student Card 	<ul style="list-style-type: none"> •End the use of plastics in the ETSIME-UPM (SDG12) •Help measure and reduce energy consumption in homes (SDG7, SDG12) •Digitalize the university card to facilitate access to the services offered (SDG4 SDG9)

Source: UESEVI

interethics, is a hybrid sustained on the principles of an ethics of responsibility (and commitment), while its dynamics stands in a case by case, cost-benefit analysis taking into account the ethical dimensions of the actors involved to get social sustainable action (Martín-Sánchez et al., 2016). The UESEVI team works to educate people in values that may adapt their professional performance towards a social leadership in the general field of education as well as in the case of engineering students. This innovative educational approach could be of special relevance to ensure that advanced technologies influence positively human development.

Actions in the Path Towards Quality

The year 2009 was an important one in Spain for the verification process of the degrees leading to the acquisition of professional competencies of the Mining Engineer (R.D. 1393/2007). This process was grounded on the last propositions and recommendations of the National Agency for Quality Assessment and Accreditation of Spain (ANECA) in its action aimed to evaluate (VERIFICA program) the proposal of the study plans designed and presented in agreement with the EHEA.

The overall curricula, as proposed by the universities, have been focused, among other points, on the quality criteria that each center has decided to establish for a good functioning.

In the case of the ETSIME-UPM, a unified criterion was adopted to emphasize those actions that may minimize the leap the students encountered when moving from secondary school to university.

This gap was known before the introduction of the new curricula (Ávila, 2010) and to deal with it, a series of actions were proposed in a centralized way.

These actions were established on a voluntary basis. The students willing to attend were enrolled in courses of a month with both the Administration and Services Staff (PAS) and the Teaching and Research Staff (PDI from the Spanish) of the respective centers. Another action launched to narrow the gap was the so called “starting point”, based on the Moodle teaching platform to level the contents of the courses where certain deficiencies were detected.

Both actions were prepared for the pre-Bologna schedule (calls in February, July and September). At present, the Bologna schedule (calls in January, June and July) is completely established, a circumstance that does not allow to carry out a zero course. This is leading to overlap between the formal training and the starting point. A zero course includes material which connects the studies of secondary school with the material expected at the first university level course.

The current action from UESEVI's point of view is not centered on the acquisition of specific skills, but it is rather focused on the development of mechanisms to help and orientate the new trainees that are based on mentoring (Mentor Project) and subsequently in academic support (Monitor Project) supplied by students from higher courses. It is assumed that the trainees learn better in a friendly and stimulating environment and it has been found that the senior students are well equipped and motivated to provide valuable help to their colleagues of the first course.

The Mentor and Monitor Projects

These two projects had been conceived as orientation actions in the formal teaching program in search of quality. This has been also the option taken in the ETSIME-UPM. It has been experienced during the program development that the projects might play an even more important role if both were incorporated into the general strategy for training in general and social aptitudes (Muñoz Ruiz et al., 2011). And since then, the Mentor and Monitor Project have become not only instruments for the orientation initiatives but also have evolved to become the beginning of a strategy aiming at introducing the trainees from the onset of their admission in the knowledge of social competencies.

The Mentor Project

The goal of this project is to improve the welcome and orientation process of new trainees through the accompaniment of students from higher courses who have passed the situation of reception (they are “mentors”) and the training in seminars about social skills that may help to make face to the university degree period, promoting a greater personal and academic development. This activity may be credited with ECTS credits.

In the course of the eight year period from the introduction of the Mentor Project in the ETSIME-UPM, it has been found that the organization in four levels of participation (coordination, form master, Mentor and “Mentorized”) may introduce some problems in the follow up of the training process. It is believed that the mentoring program relies on the interchange of knowledge between pairs. According to this philosophy, the program must be improved and thus the coordination should be carried out by

students in good cooperation with the professional tutors. The tutors contribute their experience on the university, the knowledge on the functioning and mainly providing real information on the means.

On the basis of this argument, the decision was taken to introduce the figure of “Coordinator Students”. (Figure 2)

The figure of the “Coordinator Student” trainee is that of one student that has already experienced the Mentor project, has also been acting as mentor for developing the training in social skills and who knows the dynamics of the project, the characteristics of the center and the personal integrating the PAS and PDI collectives.

The Sustainable Development Goals that are mainly worked on in this activity are the following:

- 4. Quality Education, specifically the following target:
 - 4.7 By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development
- 5. Gender Equality, specifically the following target:
 - 5.5 Ensure women’s full and effective participation and equal opportunities for leadership at all levels of decisionmaking in political, economic and public life
- 17. Partnerships for the goals, specifically the following target:
 - 17.17 Encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships

Figure 2. Mentor project structure

The Monitor Project

The Monitor project is intended to ease the integration into the University of the Newly Incorporated Students (“Mentorized”) providing academic support to them in the first course. This support is transferred through students who have already passed with satisfaction the subjects (A or A+ grade) and who have shown abilities to help other colleagues to pass the subject (monitor) with the help of a form master. This activity may also be credited with ECTS credits.

This project was developed as a pilot one during the 2014-15 academic year and was conceived as complementary to the mentor project. It originated as an initiative of Social Entrepreneurship presented by the trainees that studied the course on Ethics and Values in Engineering during the previous 2013-14 academic years.

At present, the project has a structural organization of four levels (coordination, form master, monitor and “monitorized”) but in the same plane as for the case of the Mentor project, it would be advisable to establish a fifth level of participation with a figure similar to that of Coordinator Student. It is foreseen that this experience be applied in all subjects where the evaluation process reveals low rates of approval or high rates of abandonment. Initially it has been designed for subjects of the first course, though it could be applied for subjects with similar rates of success or abandonment in higher courses

Objectives of the Reception Actions for Receiving Students

- Train the veteran students in leadership by means of an activity of academic, social and administrative orientation to the new trainees, this process being completed with seminars for training on social and transversal skills.
- Implicate the two staff groups, PAS and PDI, in the reception process of new trainees and in the training of transversal competencies of the veteran students.
- Establish a tool to detect the needs and motivations of the students who are involved in the programs through the satisfaction inquiries.
- Train the veteran students in social and transversal skills by the practice of the previously mentioned activity of academic orientation to the “Mentorized” group.
- Promote the values of compromise, personal/social responsibility with regard to all involved in the process of training (PDI, PAS, Coordinator Students, Mentors, “Mentorized”, Monitors and “Monitorized”).
- Generate an environment of collaboration and companionship among all the members of the university community what eases the building of a network aimed at fostering the professional results of the graduates.

Phases and Participants in the Reception Actions for Receiving Students

The programs oriented to welcome the students are divided into the following phases

Table 3 shows the phases integrating the projects as well as the participants who benefit from them. It is worthy to recall that in both projects, Mentor and Monitor, the participation of the trainees (newcomers and veterans) as well as the teaching work performed by the tutorial professors is essential.

Table 3. List of participants in the reception actions in every one of the phases of the projects.

Stages	Phases	Mentor Project	Monitor Project
PREPARATION	Planning of training and seminars	Coordinators	Coordinators
	Diffusion of the activities	Coordinators and Coordinator Students	Coordinators and Form masters
	Selection of veteran students	Coordinators	Coordinators and Form masters
	Captation of students of first course	Mentors	Monitors and Form masters
EXECUTION	Training of veteran students	Professors and Psychological Assistance Service	Tutorial professors
	Administrative support / Academic support to the students of first course	Mentors, Tutorial and Professors	Monitors and Tutorial professors
EVALUATION AND CLOSURE	Procedure evaluation	Mentors, "Mentorized" and Form masters	Monitors, "Monitorized" and Form masters
	Recognition of ECTS credits to the veteran students	Form masters and Coordinators	Form masters, and Coordinators
	Closure of and reflection from the project	Coordinators, Tutorial professors, Coordinator Students, Mentors and "Mentorized"	Coordinators, Tutorial professors, Monitors and "Monitorized"

Source: own elaboration

Results of the Experiences of the Orientation Actions in the ETSIME-UPM

The analysis of results reflects the observation and modification in each one of the process, thus allowing the independent evaluation. Due to the fact that the two projects have a different time frame, the results of the Mentor Project are shown before, followed by those of the Monitor Project. Finally, a comparison of the data of the two projects during the 2014-2017 courses is shown.

Results of the Mentor Project

This section collects the results of the implantation during the last eight years. A reflection on the deviations undergone during this process and the interactive process to the SIQA is outlined below.

The participation of the different stakeholders has been changing during the last years of the program (Figure 3). As can be seen, the number of mentors has reached a peak with the minimum of 10 mentors from the start in the 2010-2011 courses to the 40 reached in 2011-2012. In the following three years the number was stabilized around 30 mentors.

Until now, mentors received training in social skills while carrying out the mentoring process. However, beginning in the 2015-2016 academic year the structure of the mentor project has been modified by request of the students themselves, since they consider that the training as mentors should be prior to the accompaniment. In this way, the mentor project takes place in-between two academic years. In the second semester of one of them the formative part is carried out, and in the first semester of the following the accompaniment. As can be seen in Figure 3, this modification has caused a worse reception of the program and the results have worsened considerably, therefore, the next course we will have to consider returning to the initial structure.

Figure 3. Number of mentor's trainees

Regarding the “Mentorized” trainees (Figure 4), their number has increased since the outset of the program (2010-2011) as an experimental activity with 21 students (76% women and 24% men). This pattern is inverted from 2011-2012 onwards with higher percentages of men, ranging from 66% in 2013-2014 to 80% in 2017-2018. All the students integrated in the program belonged to the post-Bologna status. This is consistent within the process of implantation of this action of reception.

If we take into account that the number and motivation of the mentors influences in the selection voluntary process, this justifies that from the 2015-2016 academic year, the number of “Mentorized” trainees has also suffered a remarkable decrease.

Figure 4. Number of “Mentorized” trainees

Source: own elaboration

The incorporation of the Coordinator Students began in 2012-2013 with four students from the pre-Bologna status, and since 2013-2014 have been 2 students per year. There are no differences in the incorporation of Coordinator Students in relation with the nature and characteristics of the studies plan. The participation of the teaching and research staff (PDI) has also been increasing since the beginning: from two professors in 2010-2011 and 2011-2012 till 6 professors in 2012-2013 and 9 professors in 2013-2014, with 7 men and 2 women. Currently there are up to 11 professors depending on the needs of the project, 4 women and 7 men. The intervention of the PAS collective has been constant and uniform, collaborating in the program with two secretaries and a computer expert to give support for the Moodle platform.

Concerning the different productive populations involved in the project (Figure 5), the figure shows an evolution that leads to an optimization of the stakeholders. In fact, it must be emphasized the high number of mentors enrolled in the 2011-2012 academic year, when the process was in a preliminary state and the general opinion of the mentors on the teaching program was of distrust. With the evolution of the program, the training activities were optimized what implied the reduction in the number of mentors to attend the needs of the “Mentorized” trainees.

Figure 5. Comparison between the different productive populations involved in the Mentor Project

Table 4. Subjects and their respective years introduced through the Monitor Project.

Subjects	Academic Years
Technical Drawing	2014/15-2015/16-2016/17
Chemistry I	2014/15-2015/16
Chemistry II	2014/15-2015/16-2016/17
Calculus I	2014/15
Statistics	2015/16-2016/17
Geology	2016/17

Results of the Monitor Project

Note: The data shown below are based on a study in 2017 which contributed three of the authors of this chapter (Martín Sánchez, García Laso, Costafreda Mustelier, Bolonio Martín & Presa Madrigal, 2017)

The Monitor Project begins with its introduction in four subjects from first year of Energy Engineering Degree and Mining Engineering Degree. Table 4 shows those subjects, implanted in the first three years.

Two different methods have been implemented. In the first case, the reinforcement of knowledge is achieved within the classroom in the presence of the professor, who also has means to assist and solve doubts from students with a faster improvement that allows customizing the programme for the needs of the students. This method is applied in subjects such as Technical Drawing or Geology. The second method consists of the reinforcement outside school hours, counting on the professors' support, which permits solving doubts, reinforcing knowledge and consolidating knowledge supposedly acquired in High School. Subjects of application of the second method: Chemistry I and II, Calculus I and Statistics.

The participation of the students has been changing during the years of the program (Figure 6). As can be seen, the project started with 23 monitors trainees in the 2014-2015 courses and it has reached the 34 in 2016-2017.

Different indicators have been used for the evaluation of results in the past years.

- Total number of monitors participating in the project.
- Performance rate: Percentage relationship between the number of students approved and the number of students enrolled.
- Success rate: relation between passing students over attending students.
- Absenteeism rate: non-attending students over the number of students.

Figure 6. Number of Monitor's trainees

Table 5 shows the evolution in results of performance rate on different first-year subjects. It should be considered how from 2014/2015 academic year a decrease on the performance rates on Calculus I takes place, whereas the opposite happens on Technical Drawing.

Figures 7 and 8 show how obvious this raise of Technical Drawing performance and success ratio are respectively.

As for absenteeism rate (Figure 9), it is highly variated and non-stable. There is no relationship considered between Monitor Project and absenteeism.

Previous research (Álvarez, Cabrera, González y Bethencourt, 2006, mentioned in Martín Sánchez et al., 2017) present some absenteeism causes: low self-efficiency, low motivation in studies, low expectations about academic results, difficulties on the academic transition, etc.

Finally, a comparative research between performance rates on both degrees was carried out, as well as its evolution with the current data, trying to reduce the influence of certain factors (university access note, order number of the selected degree, etc.) and so studying the behaviour and response of certain subjects to the Monitor Project.

Table 5. Evolution in results of performance rate on different first-year subjects.

Percentage of Passing Students Over Enrolled Students					
Subjects	2012/13	2013/14	2014/15	2015/16	2016/17
Calculus I	51.87	47.14	38.46	33.88	25.09
Technical Drawing	50.34	70.37	79.56	73.65	78.53
Chemistry I	74.85	72.33	81.82	64.29	66.83

Source: Own elaboration source based on data provided by the UPM

Figure 7. Evolution of the performance rate on Technical Drawing expressed as a percentage.

Source: Own elaboration source based on data provided by the UPM.

Figure 8. Evolution of the success rate on Technical Drawing expressed as a percentage.

Source: Own elaboration source based on data provided by the UPM.

Figure 9. Evolution of the absenteeism rate on Technical Drawing expressed as a percentage.

Source: Own elaboration source based on data provided by the UPM.

In each rate was subtracted the annual average rate. Obtained values serve for the purpose of comparing subjects within the same year. Positive values mean such subjects display better than the rest. Our attempt, though, is to compare the evolution of each subject throughout different courses in a normalized scale for every subject. For doing that, average values on different courses for each subject were subtracted. The obtained index, which we will name “normalized performance rate”, helps us evaluating the evolution in the behaviour of subjects.

Tables 6 show the evolution of the performance ratio on Mining Technology Engineering Degree (MTED) and Energy Engineering Degree (EED). Is interesting to consider is the growing trend for each subject.

Higher values than previous years, mean the subject trends better. If we consider carefully the two subjects (Technical Drawing and Chemistry II) in which Monitor Project was applied three consecutive years, we will be able to see how Technical Drawing shows a clear raise on both degrees, except from 2015/2016 year in the case of MTED. It is actually the subject that raises the most of the entire degree programme. On the other hand, Chemistry II shows the opposite and its rates decrease.

These results make one think that, though the Monitor Project stands as a positive measure on the learning of students, its way of implementation plays a key role, being the collaboration between professor-monitor trainees and monitor trainees-student and student-professor fundamental for the purposes of expected continuous evaluation results.

General Reflection

ETSIME-UPM has designed a series of actions to host the new students. They include hosting seminars in which the installations and their functioning are shown to the students, but also the development of generic and specific skills designed in the curricula and measured through the SIQA. The authors con-

Table 6. Evolution of the normalized performance ratio on MTED and EED

	Mining Technology Engineering Degree				
	2012/13	2013/14	2014/15	2015/16	2016/17
Calculus I	10.78	3.43	-6.82	-3.63	-3.76
Technical Drawing	-20.41	9.13	23.72	6.16	--*
Chemistry I	6.02	-3.24	-3.75	-0.45	1.42
Statistics	-26.33	-4.59	19.57	11.34	--*
Chemistry II	9.95	6.27	-10.27	-5.94	--*
	Energy Engineering Degree				
	2012/13	2013/14	2014/15	2015/16	2016/17
Calculus I	12.73	4.64	-5.93	1.81	-13.25
Technical Drawing	-20.00	-3.33	3.97	10.38	8.99
Chemistry I	2.97	-2.91	4.69	-0.52	-4.25
Statistics	-18.40	9.12	15.39	-6.12	--*
Chemistry II	10.27	0.34	-1.50	-9.10	--*

Source: Own elaboration source based on data provided by the UPM

Note: This symbol (--*) means not available values for these terms.

sider that these actions have shown to be appropriate. They also consider relevant to highlight how the different competences of the degree are addressed by the projects Mentor and Monitor. In that sense, it could be said that the generic skills are widely developed in the Mentor Project and in the subjects of the degree program, while the specific skills are developed through the subjects and are completed with the Monitor Project.

FUTURE RESEARCH DIRECTIONS

On the grounds of the integrative learning process and its success, the ETSIME-UPM-UESEVI strategy will continue its path on the basis of three pillars:

1. The application of an evolutionary trajectory to combine theoretical and practical approaches to the teaching of engineering.
2. Attempts will be made to integrate the education and research activities by exploring the new dimensions and dynamics of the consequentialist ethics as it is being applied in the ETSIME-UPM-UESEVI program. The goal is to include this new perspective into the Geoethics movement to contribute to sustainability of natural resources and to gain better social benefits of the exploitation of these resources.
3. The use of social entrepreneurship and service-learning initiatives that represent the practical side of the integrative learning process, as a source and as a reservoir of new outcomes for better development of the future engineers.

The authors also would desire to attain two more ambitious goals:

1. Expand the integrative way of teaching promoting the interrelated application of the following concepts and frames: evolution and ethics, social responsibility, social economy (including branches like ecological economy and some kind of biological economy, social entrepreneurship and social learning practices. The objective is to achieve social intelligence (Figure 10).
2. Develop programs that may foster students' vocations for STEM careers.

In summary, ETSIME-UPM-UESEVI will pursue an innovative educational program embedded with innovative social parameters and in line with the SDGs.

CONCLUSION

While recognizing limitations and imperfections during the Bologna process, from the case presented in this chapter derives the idea that the SIQA strategy has evolved as a valuable driver of change in order to train students in transversal and specific competencies.

From the review of the situation and evolution of the Bologna process that has been conducted in this chapter, and taking into account the dimensions of quality and accreditation that define this process, it seems that Engineering offers very positive results in relation to the objectives of SIQA.

Figure 10. From Quality Assurance to Social Intelligence through Integrative Learning

The case study model is an instrument used and recognized in studies aimed at training managers and professionals in business, and in economic and financial fields (Business Schools, diplomas and university degrees in Marketing and Commerce, all of them examples of entrepreneurial success in USA). The application of this model to a more social objective, as is a Higher Education process managed from a public institution, has reinforced the rational of the authors searching for international diffusion of the process. This program has been oriented to the teaching of engineers by including social issues as ethics, values, and concepts and practices of social economy and social innovation, and has obtained very positive results.

The examples provided in this chapter show the integration of the teaching on ethics and the actions oriented to facilitate the adaptation of the new students of Mining and Engineering (an outcome of the quality objective) with the successful application of Social Entrepreneurship, creative innovation and Service-Learning. This integration represents a first and important evidence of the good results provided by the integrative learning trajectory. And thus leads to the incorporation of the ETSIME-UPM teaching program in the aims of social intelligence (Figure 10).

The achievement of the SDGs implies developing a set of capabilities that cannot be acquired only through theoretical training. Students must relate to their social, economic and natural environment through a participatory learning process where technical and social skills, as well as values, are taught and

This concept of integrative learning may be assimilated to the one of “educational ecosystem” that the authors wish to propose. The concept of ecosystem is becoming a mantra and so applied very frequently, but not properly in scientific terms, to design innovation and market projects and strategic issues. However, in the case study presented here and with regard to the field of education, the use seems in principle well substantiated: throughout the trajectory, there are coevolution and integration of the different phases and shareholders. All these results contribute to the recognition of values such as cooperation, empathy, and social justice. This recognition leads to social responsibility of the graduates.

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KEY TERMS AND DEFINITIONS

ACREDITA PLUS program: The main objective of the new ACREDITA PLUS program (2010), namely, to avoid the multiplicity of processes so that degree programs can obtain both national accreditation and a European/international quality label through best use being made of synergies between the two QA processes.

ACSUG: Agency for Quality Assurance in the Galician University System was legally established on 30 January 2001 as a consortium between the Regional Government of Galicia and the three Galician universities. ACSUG has full legal personality and the necessary independence to be able to achieve its objectives to rigorous standards fully respecting university autonomy.

AQU: The Catalan University Quality Assurance Agency, AQU Catalunya, is the main instrument for the promotion and assurance of quality in the Catalan higher education system. AQU Catalunya is entrusted with the assessment, accreditation and certification of quality in the universities and higher education institutions in Catalonia.

AUDIT Program: ANECA in cooperation with two other regional agencies, AQU and ACSUG, have developed the ‘Assessment of Internal Quality Assurance Systems in Higher Education’ (AUDIT program). The purpose of this initiative, which is addressed to all the university colleges and faculties that offer university education, is to provide guidance in designing internal quality assurance systems integrating all the activities implemented up until the present time related to degree programs quality assurance.

EUR-ACE®: Is a framework and accreditation system that provides a set of standards that identifies high-quality engineering degree programmes in Europe and abroad.

Group E4: Is composed by the European Association for Quality Assurance in Higher Education (ENQA, 2000), the European Universities Association (EUA, 2001), the European Association of Institutions in Higher Education (EURASHE, 1990) and the European Students’ Union (ESU, 1982).

SDGs: On 1 January 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development — adopted by world leaders in September 2015 at an historic UN Summit — officially came into force.

Social Competencies: Are those extending the ones taught in the specific degree or branch and that are attending to train the students in a series of knowledge dimensions and values which may allow them to behave as citizens assuming compromises with people as well as acting responsibly on the common goods that will fashion their Professional scenario (Environment and Society) (García Laso, 2014).

VERIFICA: Program evaluates the proposals of study plans (curricula) designed in line with the European Higher Education Area.