Environmental management and audit schemes implementation as an educational tool for sustainability

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Abstract

The trail to sustainability requires a revolution on the way environmental professionals perceive and solve environmental problems. In a globalisation context, environmental professionals have to develop new personal, interpersonal, societal and technical skills to become active throughout their professional lives and to be of value in the quest for sustainability. Professionals have to develop open mindsets, a holistic perspective of the problems and integrated solutions. Current environmental engineer courses fail to provide the required skills, due to the traditional higher education structure. The role of implementation of an Environmental Management System on campus, in providing students with the ‘hands-on’, ‘on-the-job’ business skills that will make them useful in the search for sustainability is discussed.

Keywords: Sustainability; Environmental Education; Environmental Management Systems; Globalisation

1. Introduction

“Without a conscience revolution, mankind will be doomed”

José Saramago
Literature Nobel Prize, 1998

Natural resources are suffering from severe depletion problems that can ultimately lead to a civilisation collapse [1]. Environment professionals have a relevant role in the quest for sustainability. Their training is a touchstone in the entire process and therefore needs to be analysed at the light of the new challenges posed by a changing world, where the skills for success are substantially different from those needed so far.

1.1. Education for sustainability

Education is a touchstone in the quest for sustainability. There is, nevertheless, the illusion that education will solve all our sustainability problems in the future, leading us single-handedly into the desired sustainable society. Albeit without some sort of education, we will hardly achieve the transition to sustainability, if we do not, at the same time, do everything we can to transform our political, economic and social systems into more sustainable structures, we might as well forget the education part [2].

Environmental professionals play an important role in the quest for sustainability. However they face new work constraints and have to develop new skills to survive in a context of fast changes as a result of globalisation [3]. The challenge is to prepare them to cope with societal economic and technical changes, to maintain a job and a positive role in the quest for sustainability. The environmental sector is gradually moving from an ‘end-of-pipe’ approach to environmental management holistic, process-based approaches, which require an entire new set of technical, societal, and individual skills. Environmental professionals have to acknowledge the different dimensions and complexity of environmental problems, through a more proactive attitude and the development of integrated solutions. They have to develop societal, ethical, creative, personal and interpersonal skills in addition to technical competences to be of value in attaining sustainability. These skills are also necessary to enter the labour market and to preserve/improve their own employability.
The nature of learning has been changing. Initially considered as the receiving and storing of knowledge, this paradigm has been questioned by the constructivist epistemology, which emphasises that learning is active construction of knowledge. Thus learning is understood as a continuous process where an individual constructs and reconstructs his/her conception of the world [4]. Problem solving is seen as an approach for pursuing the integration of expert knowledge. It plays a pivotal role in the development of expertise in converting formal knowledge into an expert’s informal knowledge and skills, which happens when formal knowledge is used in solving problems.

Education for sustainability has to be an interdisciplinary, holistic teaching that is able to foster deep learning, by opposition to the traditional superficial learning [5], traduced by the students’ need for ‘just-in-time learning’, this is the tendency of individuals to acquire knowledge and skills at a point of need, rather than during formal educational programs aimed at preparing individuals for future experiences [6]. A recurrent problem of environmental courses is that they are not structured to deliver problem-solving skills. Students spend most of their time working through carefully designed exercises. Real-world problems are not as neatly packaged and this results in a lack of expertise in problem recognition and definition [7]. Valo [8] considers important to provide students with off-campus experiential training, pre-professional work experience and on-the-job skills, for them to learn situational knowledge and knowledge of people, as well as process knowledge, control knowledge and knowledge of practice.

Institutions purporting to prepare students for responsible adulthood should themselves act responsibly towards the earth and all its inhabitants. This directs attention to the social and ecological costs of what comes onto campus and what leaves in the form of wastes and to the policies that govern purchasing, landscaping, architecture, transportation, and institutional investments [9].

To encourage widespread adoption of sustainable practice, educational systems need to became pro-active and develop a range of suitable programmes for students at all levels [9]. This can be achievable through the implementation of a project-based education, which presents a privileged approach to learn for sustainability, through the implementation of concrete actions in a pilot study case.

Environmentally sustainable development represents a new challenge for universities worldwide. Commitment to students does not stop with a degree or a border. Graduates are citizens of a global community, so universities are more aware of their own global citizenship [10].

1.2. Environmental management systems

The implementation of Environmental Management Systems (EMS) is a privileged holistic and integrated way to tackle environmental problems within an organisation that can be a valuable tool to improve university’s environmental performance and promote sustainability learning. EMS implementation requires trained personnel in terms of the appropriate methodology, policy formulation and implementation. They must be able to assess where and how improvements can be made [7]. There are four areas of training for the implementation of EMS [7]: (1) Environmental awareness of how environmental issues affect organisations; (2) Setting up and running systems to manage the organisation’s environmental impacts; (3) Environmental auditing; (4) Specialist training for staff.

EMS are being implemented by universities throughout the world [5,11,12], in response to calls for ecologically sustainability development and for leadership in environmental protection. Their implementation implications are seldom taken into consideration conscientiously when applied to research and teaching institutions, in terms of (i) improving environmental and sustainability teaching and research, (ii) student involvement; (iii) develop environmental and overall management skills; (iv) foster environment and sustainability concerns in all students and not only those coursing environmental subjects; (v) promote pilot research/demonstration projects involving students, to foster the acquisition of ‘hands-on’ and ‘on-the-job’ skills. This approach is fundamental since without practice, environmental education will not do more than postpone the solution to the problems [2].

The implementation of EMS at universities represents a bridge between the academic, societal and business world, forcing the environmental issues into the mainstream of management issues. Universities, by nature, address issues at the leading edge. Consequently, closer integration of academic and corporate environmental activities offers the opportunity for innovation in campus programmes and creates a culture that is more likely to promote best practices [13].

Environmental education poses an ‘interdisciplinarity’ problem, arising from the desire of many campuses to offer environmental education that collates the wisdom and experience from a wide variety of academic departments and course curricula [11]. This requires a high level of integration among different departments, and considerable amounts of team teaching. EMS implementation can contribute to solve this problem. If conducted properly they canvass the views of a wide variety of stakeholders. The implementation process reaches out across departments, disciplines and management structure to embrace the widest possible audience of participants. It involves environmental teaching across the entire curriculum, as well as campus-wide practices. More than improve organisation’s environmental performance, EMS implementation will have implications on the assumptions and beliefs shared by staff members, essential to improve their self-awareness and environmental conscience.

The availability to think holistically is a touchstone of education for sustainability. Many of the new environmental management tools (i.e. Industrial Ecology, LCA, EMS) rely on a holistic comprehension of problems and integrated responses to become effective. It is expected that a final result will be the development of a ‘shadow curriculum’, improving collaborative endeavours between students, staff and directive board [14]. The ultimate collaboration is an integration of
academic studies and physical plant operations in the pursuit of campus-wide efficiencies.

EMS implementation aims to actively involve students, to enrich their training through the development of a new environmental ethic, a holistic perspective and the acquisition of critical ‘hands-on’ and ‘on-the-job’ business skills to replicate this experience elsewhere.

This paper discusses the educational opportunities to improve environmental professionals training towards sustainability as a result of the implementation of EMAS II regulation to ESAC campus.

Students are expected to acquire competences on how to structure and implement and EMS, develop a more mature understanding of the holistic and integrated nature of environmental problems, and foster new interdisciplinary integrated solutions. This sort of experience, given by the integration of students in the project is seen as important in their training since it: (1) provides an experimental link between business and education, developing ‘hands-on’ and ‘on-the-job’ skills, including the development of societal and personal skills; (2) fosters deep learning and the consolidation of ‘know-that’ and ‘know-how’; (3) will develop the students conscience of the need to preserve or improve their own employability.

2. Environmental professionals training for the future

Globalisation has brought about high uncertainty for individuals, since jobs, communities and workplaces can be transformed instantaneously by anonymous and instable technological and economic forces [3]. To be of value in the quest for sustainability, professionals have to develop a holistic integrated vision of environmental problems, and innovative interdisciplinary solutions, and at the same time develop the skills necessary to maintain their jobs. In this context, certification and skills acquired through employment experience become increasingly important in maintaining a position in the labour market. Those who do not have these ‘human capital’ attributes, deemed important by employers, face difficulties not only in entering employment but in sustaining any kind of fulfilling career [15].

The nature of work is changing and work, in the sense of profession is being dissolved: (1) as a result of the increasing fragility of the wage relationship; (2) through the effects of the increasing ‘lightness’ of firms (i.e. the bigger they are the more they tend to subdivide until they melt into the air of ‘off-shore paradises’); (3) into competencies [16]. Until recently, people identified themselves with their work activities and the institution where they worked. It is becoming more difficult for someone to identify with ‘work’ as it assumes vol-
atile forms of production, distribution and consumption. What remains appears to be definable as ‘competencies’ acquired directly through training [16].

As ‘careers’ are being replaced by ‘jobs’, and the economy demands flexible forms of organisation and flexible/transfer-
able human resources, the central issue to be ‘employable’ is flexibility. Therefore, the acquisition of societal, personality, interpersonal and technical skills, which can only be provided by ‘hands-on’ or ‘on-the-job’ experiences, is fundamental to enter the labour market and maintain or improve their own employability.

To achieve deep learning and foster the development of professional, personal, interpersonal and societal skills, essential to the survival in a more competitive world, a change is needed on the way environmental professionals are trained.

Changes on environmental engineer training are in line with some radical international developments in the engineering realm, which aim at getting students to think, or go beyond the information given with the integrative skill of bringing knowledge, skills, understanding and experience together in problem solving activities and environment. This provides students with the best kind of preparation for life-long independent learning. At present, limited epistemological and pragmatic spaces are being allowed for students to engage critically with engineering knowledge, as well as to apply such knowledge skillfully [17]. An eclectic approach to engineering education is necessary in order that both facts (‘knowing-that’) and skills (‘knowing-how’) acquisition and application become the rationale which would enhance and expand engineering teaching and learning beyond its present reduction to factual, technical content [17]. The implementation of EMS provide a golden opportunity to foster ‘hands-on’ and ‘on-the-job’ skills, while allowing students to integrate the knowledge they learned in classes with the know-how of experience, necessary to achieve a more mature vision of the environmental problems complexity, and to develop more complex holistic and integrated solutions.

3. EMS impact on sustainability learning

Collaborative research projects are considered a valuable tool to improve in-depth exposure to the topic under study, and facilitate authentic interactions between student and teacher [18]. The implementation of EMS is expected to have a significant impact on the quest for sustainability, due to the impact they have on environmental performance, improvement of energy and raw materials management, and on its participatory dimension, able to change mentalities and to improve citizens’ conscience towards the environment and sustainability.

3.1. Compliance with statutory requirements

EMS covers all the relevant actions within an institution that have to conform the legislation in force. EMS implementation at a complex and diversified school covers a wide range of legislation, providing real examples to the students. Facing a real problem, students will understand the ‘raison d’être’ and structure of legal bodies, and will become proficient in their use.

3.2. Environmental review

This basic skill is taught at practical classes. Nevertheless, students gain business skills by participating in a study with
a broad scope of action. EMS covers the entire production system and not only the expected outputs. Therefore, students’ involvement will enhance their insight, essential to find innovative solutions based on productive systems’ improvement and not only on end-of-pipe solutions. This approach improves significantly the organisation’s environmental performance and its overall competitiveness, allowing students to foster analytic skills and develop innovative integrated solutions based on an ‘industrial ecology’ approach.

3.3. Policy definition

The organisation’s environmental policy is essential to tackle the efficiency problem. It must take into account the resources available, define the environmental goals and milestones and establish a strategy and the means to achieve the goals, in order to improve environmental and overall performance and rationalise the use of resources. This step is often overlooked, although fundamental to improve the organisation efficiency and competitiveness.

The definition and implementation of an environmental policy is the commitment to a defined environmental behaviour and the persecution of environmental goals under a continuous improvement philosophy. If well adapted, it can catalyse the environmental performance and act as a tool to change mentalities. If not, the environmental policy will be dead and meaningless. This experience can only be acquired with ‘hands-on’, ‘on-the-job’ situation, such as those provided by the implementation of EMS to a University campus.

3.4. Planning and management

The importance of planning is seldom perceived by students. Their involvement in an EMS implementation project allows the acquisition of competences that would be difficult to fulfil otherwise. The importance of developing an environmental plan is fourfold [13]: (i) Plans establish concrete guidelines, providing the guidance on how to proceed; (ii) by focussing on specific projects, plans facilitate the development of management infrastructures; (iii) by outlining future environmental developments, plans facilitate accountability and allow a better judgement of alternatives; (iv) plans can foster participation, allowing everyone’s input into the future direction of the environmental policy and implementation actions.

Planning develops several professional skills: (1) optimise resources; (2) work holistic and interdisciplinary; (3) organise and lead multidisciplinary teams; (4) communicate; (5) self motivate; (6) responsibility; (7) negotiate, argue and mediate in conflicts; (8) diplomacy.

3.5. Implementation actions and projects

The implementation of actions is a privileged way to develop critical ‘hands-on’ business skills, when students are involved in the discussion and carrying out actions related with EMS implementation. In the EMAS@SCHOOL project implementation has its roots on an ‘industrial ecology’ approach to achieve a better environmental performance at a lower cost, gives students the chance to learn how to regard the problems holistically and to find integrated solutions, evaluate risks, establish the action implementation plan, calculate the means and costs and define the skills needed to implement a given action.

3.6. Auditing and evaluation of results

Environmental auditing plays an important role on the evaluation of the implemented actions to improve the organisation environmental performance. The implementation of an EMS provides the opportunity to demonstrate and discuss the role of environmental auditing in the overall organisation performance. The ESAC’s diversity is seen as an opportunity to develop specific audit tools, which are being discussed with the students to promote the development of audit skills.

3.7. Reporting

Writing is one of the most fundamental means for achieving deep learning and holistic understanding [5]. The importance of environmental reporting is threefold: (i) it informs the wider community of the progress of the institution’s environmental plan; (ii) institutions can demonstrate their care for the environment, which helps to develop an environmental management ethic; (iii) provides a database of information on environmental management programmes, useful for environmental managers.

Reporting is an important part of an open and transparent policy, fundamental for the credibility of EMS and of the entire ‘movement’ towards sustainability. The involvement of students in the implementation of an EMS provides a valuable approach to teach skills they would difficulty learn otherwise.

3.8. Participation

Participation is a touchstone of environmental sustainability. The EMAS@SCHOOL experience of implementing an EMS to a democratic organisation revealed that although being more difficult and taking more time to implement, the involvement of the entire school community, at the policy and plan definition, and during actions’ implementation is the only approach capable of induce conscientious changes in individual behaviour towards sustainability and foster citizenships. If the programs function well, people are more likely to participate if, for no other reason, than the perceived social responsibility demonstrated in their behaviour will promote a greater sense of self-worth [13]. For sustainable development to happen it must take root in the consciousness and cultures of society [19].

By establishing a participatory environmental management infrastructure, university staff and students know with whom the responsibility for environmental programs rests, what the role of each group is, what programs are out there and who to contact about environmental issues; this fosters interest and involvement [13].
4. Development of environmental engineering skills

With a problem solving focus and involvement in real life situation, Engineering Education programmes should create space “for choices outside of traditional engineering that enhances students’ exposure to business practice, economics, politics, labour issues, the natural environment, and courses that will broaden their understanding of human interaction” [17]. The authoritarian model of instruction that dominates many engineering programmes tends to stifle or delay intellectual development. Students mature intellectually only when they are exposed to an environment that allows and fosters critical thinking [17].

4.1. Environmental engineers training

Abbott [16] describes the following sequence of professional work. (i) Diagnosis “assembles the client’s relevant needs into a picture and then places is placed in the proper diagnostic category”. (ii) Inference “takes the information of diagnosis and indicates a range of treatments with their predicted outcomes”. (iii) Treatment “imposes a subjective structure on the problems with which a profession works”. In addition, several other skills are needed for a successful professional career in Environmental Engineer, namely the capacity to: (i) innovate towards sustainable development, (ii) optimise the available resources use, (iii) predict stakeholders reaction, (iv) professional ethics and strictness, (v) work, organise and lead a multidisciplinary team, (vi) communicate (non-verbal, written, oral, multimedia, in native and non native languages), (vii) self motivation, (viii) work capacity, (ix) negotiate, argue, and mediate conflicts, (x) personnel competence (empathy, confidence, self conscience, adaptation and initiative capacities), (xi) maintain competence throughout professional life.

Central to any environmental engineer training is its interdisciplinary character. Although multidisciplinary subjects are compulsory [17] in environmental engineer courses, interdisciplinarity is difficult to achieve with traditional curricula composed by different unrelated disciplines. The problem lies with the educational structure. In fact, our educational systems and society for that matter over-emphasise left-brained analytical skills [20]. As a result, left-brained skills have become dominant for the most of the population. The left brain controls the linear, logical, and verbal abilities, while the right brain controls the visual, creative and intuitive abilities [20]. Project implementation provides the context to integrate the knowledge taught in different disciplines in the solution of real problems, establishing a bridge between different subjects. It is difficult to a new academic ‘discipline’ for transdisciplinary studies to consider effective ways to translate, reconcile and integrate disparate discourses, traditions and methodologies [21]. Traditional conservative university curricula tend to encourage conformity and a narrow intellectual focus [22], stimulating the left brain, which discerns facets and features, breaking down a whole into component parts [20]. The right hemisphere functions simultaneously or in parallel, actively seeks patterns and organising the component parts into a whole. Research indicates that learning is most productive when both hemispheres are involved in the process [20].

Different teaching approaches, involving the stimulation of the entire brain are necessary to foster interdisciplinarity and sustainability. Warburton [21] suggests systems-level thinking, supported by: (i) providing a wide range of concept and material content; (ii) illustrating interconnections and interdependence; (iii) stressing dynamic rather than fixed structures and processes. It is also important to develop an ability to evaluate critically ideas such as: (a) limits to resource availability and environmental impact; (b) valuation of environmental assets; (c) equity. Critical awareness of key concepts and the scope, limitations and complementarity of different disciplinary paradigms is a desirable outcome of environmental education. Such awareness is best developed within an integrated, interdisciplinary framework and requires the engagement in comparative and synthetic thinking at diverse levels. The implementation of the EMAS II regulation to campus involving the students is a valuable approach to deep learning of a complex topic such as the environment.

Deep learning is internally motivated and is associated with an intention to understand, rather than to simply pass an assessment task [23]. Deep learning is a key strategy by which students extract meaning and understanding from course materials and experiences. Because of the range and interconnectedness of environmental, social and economic issues, and the importance of interdisciplinary thinking and holistic insight, deep learning is particularly relevant in the context of education for sustainability [21]. However, deep learning can be inhibited if students’ interests or backgrounds have a strong disciplinary focus. Deep learning scores are affected by low morale and motivation in response to a perceived lack of employment opportunities. It may also be a result of an excessive workload: in many ways traditional teaching pushes students towards superficial levels of engagement with material, even as it hopes to do the opposite [24].

There is a holistic (global) style that attempts to create a picture of the whole task (comprehension learning) and a serialist (step by step) style that pays more attention to details and processes (operation learning) [25]. Science students can be exposed to excessive serialist teaching styles because science emphasises fact and detail in relation to specific situations and creates increasingly narrow specialisms [26]. This is a major problem for Environmental Engineers and for education for sustainability, since the type of training that is given results in the loss of the big picture (holistic) dimension, fundamental to frame and justify the actions for sustainability. An EMS project approach presents a solution to this problem, since it provides the focus on the definition of sustainability goals, (i.e. environmental policy), a development strategy (i.e. Planning and management) and actions and sub-projects implementation. Environmental auditing provides a further control and integration dimension. The involvement of students in such projects will develop the holistic vision that would be difficult to reach with other approaches. The complexity of EMS implementation to a campus, offer good models to develop
curricula in order to encourage critical and creative thinking, problem-solving, effective decision-making and conflict resolution. Project based education combines mastery learning and discovery learning. A curriculum should facilitate mastery learning (through considerations of planned sequence, essential content, learning materials and format), while providing opportunities to benefit from discovery learning through curiosity, independence and enhanced personal meaning [21]. Project based learning enhances deep learning by providing a cooperative, active learning environment which is hardly provided by a traditional lecture format [10].

Curriculum actions can embody a wide variety of ways that educators can improve sustainability education, typically through repeated cycles of planning, action, observation and reflection [21]. Sustainability education improvement can be designed to provide students with tools to stimulate critical evaluation and the connections between concepts. By providing such a learning environment, the EMAS@SCHOOL project fosters deep learning, the acquisition of interdisciplinary connection and business skills. A project will allow students to reflect on their learning and leads to changes in values, attitudes and behaviours, essential for effective education for sustainability [22]. In this way, students become aware of issues, gain analysis and research skills, learn about effective remedial strategies and develop an in-depth understanding of underlying concepts. Sustainability requires a change on one’s basic values, feelings and beliefs, which according to Grassholz [5] can only be attained with deep learning.

Table 1 presents an evaluation of traditional types of teaching approaches and their ability to fulfill the skills that the authors considers necessary for a successful environment professional. In addition to the acquisition of information (know-that) on several subjects, it is judged important the development of several ‘self capacities’ and interpersonal characteristics, essential to foster an open mind to change, develop a proactive, holistic approach to new solutions and technologies, and being able to interact with and persuade others to act sustainably. These skills are seldom fostered in theoretical classes or field trips. Practical classes, with the production of essays, have a limited impact upon the development of those skills, while the full involvement in the project discussions and actions are a privileged way to foster critical business skills.

A dimension allowed by the ‘hands-on’ approach resulting from students’ participation in the project, is the integration and implementation of knowledge in a business environment. Environmental courses approach the environmental management tools from a theoretical ISO perspective, where EMS, LCA, etc., are presented as an end in itself, reducing the potential added value of their integration. The ‘hands-on’ approach fosters this integration and allows a higher level of contact with the problems, allowing improved levels of learn and training. A project-based learning approach provides a privileged contact with the public and the art of participation organisation, which fosters transparency and dialog skills, turning the participation process into a non-formal learning opportunity for all. The involvement on an EMS implementation provides an opportunity to promote the philosophy of “education that goes beyond the classroom” [9].

5. Case study

The Escola Superior Agrária de Coimbra (ESAC) is a public agriculture university college, of 142 ha, located within the Coimbra urban area, in the Portuguese Central Region. With 1100 students and 200 staff members, it provides degrees in Environmental, Food, Forest Resources, Agriculture and Livestock Engineering, and Ecotourism.

ESAC is currently implementing an Environmental Management System based on EU EMAS II regulation (Regulation (EC) No 761/2001), under the Life Environmental financed EMAS@SCHOOL project.

The actions involved are: the environmental review; the EMS definition and implementation; the wastes and wastewater management systems implementation; the management plan implementation and the recovery and valorisation of sensitive forest areas; the agriculture and animal husbandry environmental improvement and the dairy industry pollution effect reduction (Fig. 1).

5.1. The role of higher educational institutions in teaching sustainability

Van Weenen [12] identifies four levels of university engagement. (1) The university is assessed as an organisational unit that uses materials and energy, facilities and space. It relies both upstream and downstream on suppliers and on
service providers. ESAC is implementing an ‘industrial ecology’ approach, taken advantage from the diversity of activities and ESAC’s spatial dimension. Contracts with cleaner firms and other service and material providers were reviewed to include environmental concerns. (2) The University adds to its operations, its core interest in research and education. The objective is to provide in-house work and stimulate, support, steer or start university development concerning buildings, facilities, the campus, infrastructures transport, etc. ESAC is using EMS implementation to foster research and teaching for sustainability, create infrastructures and knowledge in environmental sustainability subjects across its activities (farm, forestry, dairy industry, school buildings and administration). This approach, seeks to involve all the departments and students from all the courses, making environmental concerns transversal to all ESAC courses. (3) University engagement involves management, including the formulation or reformulation of its policy. University management can set the conditions and mechanisms to stimulate assess and evaluate progress in the integration or organisational redesign required to meet the sustainable development challenge. ESAC is greening its attitude and policy by re-thinking its environmental policy and using sustainability as a ‘leitmotiv’ to make ESAC more competitive, by rationalising their production factors, and foster curricula development, making graduates more prepared to the changes society will face in the future. This will increase students’ employability and ESACs’ teaching quality. (4) Redefinition of university mission statement. A strong and convincingly formulated mission statement provides mental support to the whole university community and the outside world. ESAC is becoming aware of its role in education for sustainability and its impacts on regional development. The definition of an environmental policy which aims at the implementation of an ‘Industrial Ecology’ philosophy, embodied by a set of specific environmental infrastructures, is being used to solve ESAC’s environmental problems and as teaching and training tools, with accent on the dissemination of sustainable actions and principles.

5.2. Educational objectives

The project included a change on educational objectives and approaches centred on the students, and an improvement of ESAC’s environmental infrastructures, which will support and improve the teaching of related disciplines.

EMS implementation is expected to contribute for the students’ holistic deep learning, increasing mental and technical competences, namely in terms of integrated thinking, to make them proficient in EMS implementation and environmental audits performing. This will provide hands-on business skills, which will foster individual characteristics such as commitment, responsibility, and interrelation skills, essential to promote public participation and societal commitment towards sustainability. This is sustained by the building of environmental pilot infrastructures to improve practical lessons. The implementation of an EMS provides a golden opportunity to

Fig. 1. EMAS@SCHOOL tasks.
develop theoretical and practical work, and provide holistic examples. The application of EMS to non-industrial sectors opens new markets. The opportunity to foster participation, providing the context for students and staff involvement is a further innovation. The ultimate aim is to improve overall institutional self-esteem, institutional ambience and scientific productivity.

6. Student involvement

Student involvement is reported by several authors [5,6,12,21,24]. They consider student involvement as a key factor, often at the basis of EMS implementation decision and becoming enthusiastically involved at several stages.

Students are an important part of ESACs’ community and therefore their involvement is fundamental in all participatory process stages. The participative dimension is important since the EMAS@SCHOOL project aims at the involvement of the entire community, not only at the decision-making or planning levels, but also implementing the actions in the field. Students’ involvement in is seen as an opportunity to develop ‘business skills’, necessary for their career. All students, including those not attending environmental subjects are invited to participate actively in the implementation of actions set to improve the environmental performance of their specific field of activity. The project is transversal to all the ESAC courses, and in some cases environmental concern is brought to those courses for the first time.

The greatest leverage in working with students is to engage them actively in a project. This includes [27]: (i) a shift of mind to understand their actual capacity to influence systemic change; (ii) introducing systems thinking concepts to deepen understandings of organisational irrationality and how the university actually functions; (iii) developing a shared vision by providing enough information and training and facilitating dialogue; and (iv) building team learning capabilities by organising and facilitating regular meetings, building personal mastery by establishing a context for personal learning and openness.

Students’ involvement expects them to: (1) become aware of EMS implementation complexity; (2) understand the strategies to overcome the difficulties of engagement and involvement; (3) become aware of the environmental review techniques; (4) become in touch with an ‘industrial ecology’ philosophy as a way to integrate the institution’s environmental and performance problems.

6.1. Vectors of involvement

The aim is making students the engines of their own training. Deep learning is limited by students’ culture, which limits itself to focusing on short-term project victories rather than longer-term systemic transformation [27]. Nevertheless they have an important role in sustainability, since students acting as ‘green’ examples to their fellow students might also be effective, as the attitude comes from peers, and not just from staff “telling them what to do” [28].

The implementation of the EMAS II regulation at ESAC provides a meeting point for students and academic staff across a range of disciplines, with the consequent opportunity for the exploration of research and educational aspects of environmental matters [29]. Students’ involvement is fostered at:

1. **Discipline level**: the project provides state of the art examples and matter for the students to produce essays at specific environmental management and technologies disciplines.

2. **Probations**: provide real critical ‘hands-on’ career skills development opportunities. The EMS implementation allows training in a holistic, interdisciplinary environment. The project provides the resources, the infrastructures, equipment and also the context for students to develop their work and strength their skills, perspective and knowledge in environmental sustainability. In addition to learning how to implement Environmental Management tools, students become aware of the problems of stakeholders’ involvement.

3. **Volunteer work**: following the discussions of policy, strategy and actions, several actions are being implemented in the different project tasks with the help of voluntary students.

Student involvement is seen as an opportunity for holistic teaching and for deep learning in the sense that it changes one’s basic values, feelings and beliefs [5], condition essential to attain sustainability. The volunteer work widens students’ perspectives and since the students are volunteer and highly committed, a holistic teaching strategy, as prescribed by Graverholz [5] is being implemented.

For environmental technology initiatives to be effective in economic regeneration, the economic circumstances and the technical and managerial skills need to be in place “to ensure that technologies can be absorbed, adapted, used and diversified” [7]. The training of professionals plays a key role in this process. Nevertheless the instruments and mission of environmental professionals has broadened its scope over the last decade. Today the role of an environmental professional goes beyond the simple prescription of end-of-pipe solutions that increases the raw material, energy and manpower costs in order to keep pollution outputs within the legal limits. The quest for sustainability requires more pro-active and integrative solutions, capable of reducing energy and raw materials consumptions and foster more eco-efficient products and solutions. Environmental management has developed such instruments, although the maximisation of its beneficial effects, which needs a holistic vision of reality and integrated solutions, can hardly be taught at the classroom. To develop ‘hands-on’ ‘business skills’, a project based experiment is required.

Students have a relevant role in getting the university to become environmentally responsible in campus operations, curriculum and research [27]. Nevertheless, their involvement is not homogeneous. Environment students are actively involved in all project phases and tasks, including planning and
management tasks and all the thematic phases. Students from other courses are mainly involved on tasks related to their area of interest. Their involvement in the project is a privileged opportunity to foster environmental sustainability concern and implementation strategies. Students will cry for environmental sustainable sound solutions in their future work places, especially if the solutions are integrated and represent an improvement in overall organisation competitiveness.

The main aim is to foster critical ‘hands-on’ career skills and gain experience on how to implement Environmental Management tools. This is fundamental to pursue environmental sustainability [30]. To learn how to communicate, interest and commit all the stakeholders and promote a democratic, participative and fair process, is only possible in practice. EMS implementation provides such an opportunity.

The capacity to think holistic is seldom taking in consideration in most of the current higher education environmental courses. Universities privilege an analytic approach which splits the reality in parts, missing the big picture and the relations between the parts, being therefore of little help when dealing with real world problems and find integrative solutions based on a ‘industrial ecology’ philosophy.

A further aim is to strengthen the ‘job-specific focus’, aimed at filling the gaps in knowledge and skills that will help individuals find employment and be involved in environmental and development work [7].

The project enables self-determination in learning. This means that in the scope of the project students are empowered to take their learning into their own hands. This will help to make them fully responsible citizens, capable of putting what they learn into the context of their practical life.

The project is offering students and members of staff a greater sense of participation in, and responsibility for, and an opportunity to have a role in the creation of a more sustainable campus. This is achieved through a project-based learning, where students are involved in the environmental review, becoming aware of the sources and impacts of pollutants. In addition, they are involved in the monitoring of different treatment options and overall difficulty associated with the mitigation of the different types of pollution.

The project also gives a scope and context to do the following. (i) Improve and actualise the course structures, which will incorporate closely the innovations in the environmental field, namely those resulting from the implementation of an ‘industrial ecology’ philosophy to a complex organisation, which implies a proficiency in the use of several environmental management tools. (ii) Improve the disciplines contents by the use of examples provided by the project. This includes the infrastructures and equipments acquire and built. Students are asked to develop specific essays using those resources in order to acquire hands-on competences. (iii) Provide infra-structures, equipments, pilot equipments (i.e. inverse osmosis and nanofiltration techniques, the implementation of a waste management system, including a composting plant and pilot waste treatment plants). (iv) Incorporate team-based learning as an integrated part of the course in the future.

7. Conclusions

The EMAS@SCHOOL project is an important tool to foster education for environmental sustainability in all the ESAC graduate courses. This will be achieved through the creation of infrastructures, equipments and best practices examples that will be used as teaching tools for the different disciplines. All the actions are integrated in an EMS, and due to the complexity of ESACs’ activities and environmental performances, provides an excellent example on how to implement integrated solutions based on an ‘industrial ecology’ philosophy.

The quest for sustainability requires a holistic vision, a more pro-active attitude and integrated solutions, capable of improving overall organisational, energy and raw materials management, and the production of more eco-efficient products.

The project provides a meeting point for students and academic staff across a range of disciplines, providing new opportunities to improve curricula contents and providing new examples and ‘hands-on’ opportunities to push forward research and educational aspects of environmental matters. Such integration between research and education in a ‘business environment’ where problems were identified, solutions developed and discussed through a participatory approach and actions planed and implemented, is a desirable goal in enhancing environmental education quality.

A project-based training allows the development of ‘hands-on’ business skills, which include personal, interpersonal, societal skills, which allied to a holistic vision and mindsets attentive to integration possibilities and consequently to lower costs, provides ESACs’ graduates with the tools to enter the labour market and preserve and improve their own employability throughout their active lives. These skills and attitudes are fundamental to build a career and survive professionally in the present globalisation context.

Being active, open-minded and searching for integrated solutions to complex problems are valuable attributes in the quest for sustainability.

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References


