World Sustainability Series

Walter Leal Filho
Luciana Brandli
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Julie Newman *Editors*

Handbook of Theory and Practice of Sustainable Development in Higher Education

Volume 1

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Handbook of Theory and Practice of Sustainable Development in Higher Education

Volume 1

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Preface

We are pleased to introduce the first volume of the "*Handbook of Theory and Practice of Sustainable Development in Higher Education*".

This publication, which consists of a set of volumes, introduces many of the papers discussed and presented at the World Symposium on Sustainable Development at Universities (WSSD-U-2016), which was held at the Massachusetts Institute of Technology (MIT), in Cambridge, MA, USA, in September 2016.

The aims of WSSD-U-2016, consistent with the goals of the WSSD-U series, were:

i. to provide universities all round the world with an opportunity to display and present their work (i.e., curriculum innovation, research, activities, and practical projects) relating to education for sustainable development at university level;
ii. to foster the exchange of information, ideas, and experiences acquired in the execution of projects, from successful initiatives and good practice;
iii. to discuss methodological approaches and projects which aim to integrate the topic of sustainable development in the curriculum of universities;
iv. to network the participants and provide a platform so they can explore possibilities for cooperation.

Last but not least, a further aim of the event was to document and disseminate the wealth of experiences available today.

To this purpose, the "Handbook of Theory and Practice of Sustainable Development in Higher Education" has been produced.

This volume is structured around two parts. Part I, under the heading "Sustainability in University Contexts," presents a set of papers which describe a variety of ways via which sustainable development issues are handled in university structures. Many institutions have programs focused on building sustainability leadership skills, with varying designs and skills emphases, but these are hardly ever presented in an integrated way.

Part II focuses on "Implementation of Sustainability in Practice" and outlines examples where sustainability matters have been taken into account and implemented. In this section, readers will have here access to a formidable body of information and knowledge on matters related to the implementation sustainable

development in higher education, which will hopefully be helpful to them, and may inspire further works.

We thank the authors for their willingness to share their knowledge, know-how, and experiences, as well as the many peer reviewers, who have helped us to ensure the quality of the manuscripts.

Enjoy your reading!

Hamburg, Germany — Walter Leal Filho
Passo Fundo, Brazil — Luciana Brandli
Coimbra, Portugal — Paula Castro
Cambridge, USA — Julie Newman
Winter 2016/2017

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Part I
Sustainability in University Contexts

Inclusion of Sustainability in University Classrooms Through Methodology

Esther García-González, Rocío Jiménez-Fontana, Pilar Azcárate Goded and José M. Cardeñoso

Abstract

The aim of this paper is to presents an analytical instrument (HAMS, in its Spanish acronym), aimed at the study of teaching methods and the inclusion of Education for Sustainable Development (ESD) in university classrooms. HAMS is based on a review of studies focused on this field, and the process of developing had revealed methodological strategies in this regard. The focus of HAMS is the study of teaching and decision making in university classrooms, at both planning and intervention levels. Its development is part of a study that analyses the methodological strategies from the perspective of the values of ESD, and on the basis of the principles of complexity. HAMS should be useful for university teachers when analysing and reflecting on their teaching practice. Also, HAMS may be of use to university authorities to detect obstacles in the performance of their instructors, and to plan and design activities that allow for the inclusion of ESD in their centres. This activity has been identified as one of the priority areas for action in higher education because of its direct impact on the formation of future professionals.

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Keywords
University teachers · Education for sustainability · Teaching methods · Complexity

1 Introduction

This study arose from the need for changes to be made in society and in society's relationship with the environment, in order to improve the current worldwide situation of crisis. It is urgent for steps to be taken towards a change in mentality and beliefs, as well as in institutional and individual values and actions. And such steps need to be led by our universities (Leal Filho 2009) since the university is responsible for training professionals who will be faced with solving the systemic problems that we are suffering. One of the criticisms made of ESD is the lack of methodological proposals for the university context. Among the reasons for this situation is the difficulty to institutionalize sustainability in higher education, as this would require an organizational restructuring of the university educational system (Tilbury et al. 2004). The very transdimensional nature of sustainability may hinder its translation to an educational praxis. From a complexity and sustainability point of view, it is essential to insist on the need for educational innovation that includes sustainability with approaches that facilitate interdisciplinary thinking (Warburton 2003).

We believe that the inclusion of sustainability must begin in university classrooms (Cebrián et al. 2014). These can be scenarios for change, provided that the instructor develops holistic teaching and learning methods. These practices should promote the formulation of socio-environmental problems, and encourage critical reflection and the exchange of information and ideas. In short, they should generate divergent and creative thinking in the search for solutions. The purpose of the study carried out was to characterize the methodological strategies for the inclusion of ESD in university classrooms.

As referents, we took the studies of the Network for Greening the Curriculum (Junyent et al. 2003) and of Cardeñoso et al. (2013). In our study, the instructor is considered to be the main dynamizing agent of the process. It also considers a series of methodological elements which favour the inclusion of principles of sustainability in classes. The combination of these two aspects at different levels of complexity, and their interaction with the agents that make up the class—the students and the content—can be a way to orient the inclusion of sustainability in the university context. The characterization of these methodological strategies and their contrast with empirical data have led to the development of an instrument for the analysis and self-analysis of teaching practice from the perspective of the principles of sustainability and complexity.

2 Education for Sustainable Development, and Teaching Methods in the University

One of the objectives of ESD is to form professionals who are able to deal ethically and responsibly with the socio-environmental conflicts that they will encounter in the exercise of their profession (Azcárate et al. 2012). In this sense, progress has been detected in different areas of knowledge regarding the integration of sustainability in universities. But it is necessary to go into greater depth in proposals that show the real changes that this integration may lead to (Leal Filho 2011). It is still a challenge to include sustainability in a broad and holistic sense (Jones et al. 2010).

To advance in this integration, it is necessary to initiate changes in university classes for these to become the generating nuclei of a culture of sustainability. This will be possible through, among other routes, the implementation of methodological strategies that are in line with the principles that promote sustainability: the principles of ethics, holism, complexity, globalization, mainstreaming, and social responsibility in the university (C.A.D.E.P.-C.R.U.E. 2012). Reflecting these principles in the classroom requires a methodological organization, structure, and functioning that facilitate them. Classes should also be permeable to other complementary actions and proposals that filter down from other levels of the institution and society (Wiek et al. 2014). This may then spread to inundating the rest of the university, and thence to society in general. Instructors, students, and content are the elements of flux that extend out to other foci such as educational programs, the faculty in general, and the university community, and vice versa, fostering dialectic interaction in different directions. Thus, with the university as referent in the creation of scientific and human knowledge, sustainability may then be transferred to the rest of society (Fig. 1).

ESD provides educational bases on which to design methods that foster critical and creative thinking, competencies, and decision making and problem solving capacities (UNESCO 2014). This is always from a cross-disciplinary perspective (Lozano et al. 2013).

In this study we propose a transformation of the form of teaching which involves an in-depth rearrangement of its epistemological presuppositions (Sterling and Thomas 2006). In particular we understand the knowledge the teacher develops in the classroom as being instrumental so as to address socio-environmental problems and promote the development of the competencies necessary for sustainability (Rivero et al. 2011).

The methods that we shall present are extendable to all university classrooms because of their open character. They can be adapted to the particularities of each discipline. The objective is not only for the students to be able to propose effective technical solutions, but for them also to understand the depth and scope of socio-environmental problems and to analyse them critically (Thomas 2009), in order to be able to act accordingly in the development of their profession.

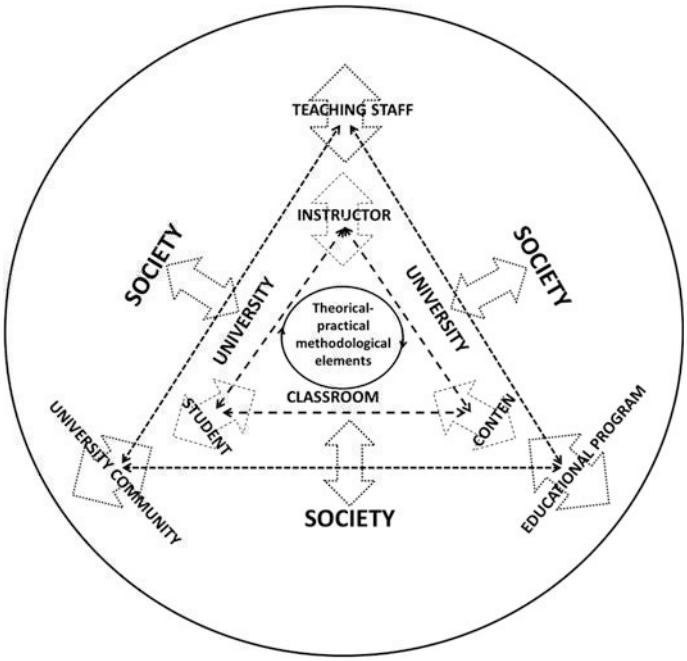

Fig. 1 University classroom system and its interaction with the social environment. *Source* The authors

Our methods respect the complexity of the processes of teaching and learning. They take into account the coexistence in the classroom of ideas that are mutually exclusive, but are inseparable and complementary (Morin 2008). They are articulated through the dialogue between theory and practice, as reflected in the two levels of educational action—planning and intervention. In both, there coexist various characteristic methodological elements, defined through two opposite extremes that interact with the three agents involved—instructor, student, and content—thus configuring educational action. The treatment in the classroom of these methodological elements, and their implementation in actions consistent with sustainability, allow the two levels and their reflection in the different agents involved to be characterized (García-González et al. 2015). These methodological elements are:

- *Teacher-student relationship: Vertical↔Horizontal*

The vertical perspective takes the instructor to be responsible for the teaching and learning process. The horizontal one gives each individual an active role in the process (Viladot and Pedreira 2012). The integration of sustainability configures a process in which the instructor acts as the mediator bringing into play the tools for

learning, and in which the responsibility for what happens in the classroom is shared between the students and the instructor.

- *Competencies: Specific↔Transversal*

The competencies for sustainability should enable the individual to cope with socio-environmental problems, and prepare students to make complex assessments of their own work and of that of others, and to make decisions in the unpredictable circumstances that they will encounter in the future (Wiek et al. 2011). A specific competency defines the concepts to be learnt, and a transversal competency links the content with the surrounding medium. Sustainability allows the two types of competencies to be integrated.

- *Socio-environmental reality: Unintegrated↔Integrated*

In our classes, involving the socio-environmental reality with which we interact fosters the students' autonomy, responsibility, and capacity for commitment. It shows that knowledge can be approached from different directions, and that there are various ways to solve any given problem. Bridges need to be built between this reality and knowledge of the discipline, facilitating the systemic and cross-disciplinary perspective of sustainability (Wals and Jickling 2002).

- *Resources: Internal↔External*

It is necessary to combine the use of internal resources, whose function is to organize the teaching and learning process, with the use of resources existing in our environment (dialogue with experts, field trips, direct interventions, addressing socio-environmental problems, practice in specific centres, …). The aim is for the environment to enter the classroom (Wiek et al. 2014) and for this to get out of the university. The aim is to make use of all the resources available to us, enhancing the synergies that arise when they are put together in order to promote sustainability.

- *Evaluation: Accreditation↔Procedural*

Accreditation evaluation is a final assessment, guaranteeing to society what has been learnt. Procedural evaluation covers information about the process and the participants, and the results have an impact on both, allowing for improvements to be made to the process (Sanmartí 2007). It takes account of cognitive, affective, and action aspects. The two functions are complementary. One is required by the legal context, and the other to regulate teaching and learning. Evaluation understood as reflection, valuing, and an element for improvement is an essential component for students to cope with the complexities posed by the socio-environmental problems that they will face in their daily lives and in their working environment.

- *Classroom dynamics: Closed↔Open*

Closed dynamics are needed to put order into ideas, to settle bases, and to provide orientation. They should alternate with open dynamics that allow the inclusion of new content, areas of interest, or problems. The teacher should encourage the formulation of questions, offer new insights, and highlight curiosity as a stimulus to building knowledge (Bonil and Soler 2012). A classroom dynamics consistent with the principles and values of sustainability means giving voice to the students so that they can negotiate and take sides in class. The idea is for them to make decisions independently—decisions that are informed and responsible.

- *Class work: Individual↔Group*

The contrast between individual and group class work causes cognitive conflict (Coll 1994). This leads to reflection on and restructuring of ideas, making learning possible through active dialogue with the rest of the group and then solidification through personal reconstruction. The synergy between the two strategies endows the learning with meaning. From the perspective of sustainability, this combination promotes the integral formation of the individual, recreating situations that the students will encounter during their professional and personal lives. The focus is on the responsibility of group work, communication, strategies for learning, criticizing, and addressing knowledge through negotiation of meanings.

From the combination of these methodological elements in their implementation in class and their interaction with the agents of the teacher, students, and content, there will emerge the approximation of these practices to the principles of sustainability. The goal is to form agents of change—students who understand the scope of the socio-environmental crisis, able to transform their reality by constructing a sustainable environment through their profession and their active involvement in society.

3 HAMS: A Tool for Methodological Analysis from a Sustainability Perspective

From theoretical background, we have developed a qualitative research, and it has led to develop a tool for methodological analysis from a sustainability perspective (HAMS, in its Spanish acronym). We have been done a case study. In this case study we analyse teaching practices from a perspective of the principles of ESD. We have selected three teachers of different knowledge areas: education, environmental science and economical science.

The data was collected through questionnaires, interviews and video recordings of the lessons. We constructed the tool HAMS, a system of categories on the basis of the aforecited theoretical referents for the qualitative data analysis. The design of HAMS are based in a validation process (Litwin 1995). This had four stages. Phase 1, we constructed the system only from theoretical referents. Phase 2, the system was subjected to a procedure of validation by experts in sustainability and university education. Phase 3, we have analysed the system in our research group and finally in the phase 4 we contrasted the system with the data.

HAMS takes the classroom to be a complex system, allowing how it functions to be analysed as a set of interactions between its component parts (Jiménez-Fontana et al. 2015). These relate to the three agents, teacher, students, and content, in their interaction with the methodological strategies put into play at both the planning and the intervention levels. All of these—agents, strategies, and levels—become the dimensions for analysis.

The methodological strategies described above move between the two extremes which define them, offering a broad set of possibilities corresponding to the decisions the teacher might make on how to implement them in class. In HAMS, we have included these possibilities as indicators, in gradients ranging from simple states in which there is no presence of sustainability to complex states in which it forms an integral part. There are three types of gradient: Gradient 1, containing five indicators; Gradient 2 with four; and Gradient 3 with three indicators. They are all functions of the characteristics necessary to describe the methodological element in question. The highest numbers of the indicators correspond to the states of greatest integration of sustainability. This case would be the most complex, and requires a balanced integration of the two extremes of the methodological element. The more complex, elaborate, and reflective the teaching practices, the more they would favour the inclusion of sustainability since they will be more in tune with the principles it promotes.

Tables 1, 2 and 3 present the HAMS instrument, differentiating it for the three agents that make up the system of the classroom—teacher, student, and content. The two levels of planning and intervention are considered, within which we include the different methodological strategies with their corresponding indicator gradients.

Knowing to what extent the teaching practices we employ promote the presence of sustainability in our classes requires a view of all the aspects reflected in HAMS. One can only understand a process of teaching and learning through the interactions and synergies that arise in joining agents and methodological strategies together.

Applying HAMS to teaching practice will not only serve to determine the extent to which sustainability is present in our classrooms, but also to point to possible actions that may help make advances in this direction, since the indicators are specified in actions that favour that purpose.

Table 1 The main dialogic axis, secondary dialogic axes, and indicators for the teacher as agent

Teacher		
Main dialogic axis	Secondary dialogic axes	Indicators
Planning	Teacher-student relationship, Vertical↔Horizontal	1. In the planned methods of working, the teacher is the principal agent of the process 2. In the planning, the students are granted a certain role, but it is the teacher who calls the tune 3. The methodological plan reflects the participation of all the agents in the process of teaching and learning
	Competencies, Specific↔Transversal	1. All the competencies are formulated in specific terms linked to the subject 2. The specific competencies linked to the subject are maintained and some new transversal competencies are formulated 3. The competencies are formulated in comprehensive terms, with a confluence of the specific and the transversal competencies
	Socio-environmental reality, Unintegrated↔Integrated	1. The socio-environmental reality does not appear in the planning of the course 2. There are some allusions to the socio-environmental reality 3. Clear indications are made to the socio-environmental reality, although in a parallel form 4. The socio-environmental reality is the hub around which the course is planned and designed
	Resources, Internal↔External	1. In the planning, reference is made only to resources of the internal context: seminars, laboratory, ICTs, library, … 2. Apart from common resources of an internal context, the planning also alludes to the use of some other resources linked to the environment 3. The environment is regarded as a fundamental resource in the teaching and learning process
	Evaluation, Accreditation↔Procedural	1. The planned evaluation focuses only on the student, and uses tests or examinations at the end of the process 2. More than one assessment instrument is planned, during or at the end of the process, but they are only targeted at the students 3. Evaluation appears in the planning at different times, using different instruments and sources of information 4. Evaluation is considered in the planning at different times, using different instruments and sources of information, and regulating all the elements of the process

(continued)

Table 1 (continued)

Teacher		
Main dialogic axis	Secondary dialogic axes	Indicators
Intervention	Teacher-student relationship, Vertical↔Horizontal	1. The teacher is the only agent choosing and directing the teaching and learning process 2. The student acquires a certain role in the teaching and learning process, but it is the teacher who directs and leads it 3. The teacher brings into play a process of teaching and learning considering new content and concerns that are worked on temporarily, without substantially changing the original planning 4. The teacher's reactions to contributions from the students facilitate their participation, and they acquire a greater role 5. The teacher acts as a mediator/facilitator in the teaching and learning process, so that the dynamics of the class are open to all participants
	Competencies, Specific↔Transversal	1. The teacher does not refer to the role as agents of change that the students have, and will have as future professionals of the discipline they are studying 2. There are hints, but not direct or clear, about the students' engagement with the development of their profession 3. References are made to the problem-solving responsibility that the students will have as professionals
	Socio-environmental reality, Unintegrated↔Integrated	1. The discourse does not include the socio-environmental reality, but is restricted to the topics of the subject being taught 2. The discourse includes some socio-environmental aspects, but preferentially linked to the dimension nearest the discipline, without addressing the interactions between all the dimensions involved 3. The discourse promotes civic values and social participation, addressing possible social, economic, and environmental interrelationships 4. Different ethical positions on the socio-environmental reality are brought into play and analysed 5. Environmental, social, and economic interrelationships are addressed; contributions from different disciplines and other fields of knowledge are included from an interdisciplinary or multidisciplinary perspective
	Resources, Internal↔External	1. The classes are developed with the use of resources from the internal context, with no regard to the external context 2. Reference is made to the existence of external resources, but as mere information to be considered 3. The possibilities of intervention in environmental issues is openly admitted, but without encouraging active participation

(continued)

Table 1 (continued)

Teacher		
Main dialogic axis	Secondary dialogic axes	Indicators
		4. Involvement in local socio-environmental problems is promoted and encouraged 5. Internal and external resources are used indistinctly and conjointly, encouraging interaction with the environment
	Evaluation, Accreditation↔Procedural	1. The student is evaluated through partial or final tests or examinations 2. As well as examinations, use is also made of individual work, class participation, involvement, etc., but with a focus only on the student 3. Different evaluation elements are used by the teacher, and the student's self-assessment and co-assessment at different stages of the process are also taken into account 4. Evaluation takes place throughout the process, with different instruments, and with the participation of both the teacher and the student; the information obtained influences the course of the process
	Classroom dynamics, Closed↔Open	1. The questions/strategies used have a single answer 2. Although different answers to the questions posed are valued, only that foreseen by the teacher is considered correct 3. Questions/strategies are formulated as a means to learn what interests the students, to refocus the activity, and to present other information 4. Divergent and diverse responses to the same question/strategy are encouraged and valued without there being any single foreseen answer
	Class work, Individual↔Group	1. The student in class only takes notes and then prepares individually for the tests or final examinations, without interacting with peers 2. Unidirectional and vertical class participation is facilitated 3. Both individual and group work in class and outside, encouraging teamwork. The interests of the whole class and the individual are taken into account 4. The work is organized in cooperation among the participants, with decisions having to be made as a collective, but coordinated with individual dynamics

Source The authors

Table 2 The main dialogic axis, secondary dialogic axes, and indicators for the student as agent

Student		
Main dialogic axis	Secondary dialogic axes	Indicators
Planning	Teacher-student relationship, Vertical↔Horizontal	1. In the planning of the course, there is no space allowed for students' contributions 2. Students and their interests appear as an element to consider, but they do not have the principal role in the teaching and learning process, which instead is led by the teacher 3. In the planning, reference is made to the involvement and active participation of the students in the process of teaching and learning, with the possibility of them making decisions
	Competencies, Specific↔Transversal	1. The competencies of the course are focused on developing the capacities of the subject in accordance with the official curriculum of the degree 2. In the competencies of the course, some reference is made to the students' role as professionals, but without any clear linkage with the results of learning 3. In addition to the particular competencies corresponding to the subject, there is included the formation of professionals with a commitment to improving their environment and of citizens who are critical and autonomous
	Socio-environmental reality, Unintegrated↔Integrated	1. In the planning, the socio-environmental reality is not linked with the students' future role as professionals 2. Some relationships are made between the socio-environmental reality and the students' future role as professionals 3. The socio-environmental reality is considered to be a pillar of the formation of the students for their professional development
Intervention	Teacher-student relationship, Vertical↔Horizontal	1. The participation of students is directed and mediated by the teacher 2. The students are involved and participate spontaneously in the development of classes, without waiting for the teacher's invitation to do so 3. The students can express their views on the process, but it is the teacher who makes the final decision 4. The students actively participate in the process, but instead of encouraging them going into greater depth in this participation, the class is led back to the initial planning 5. The participation of the students is part of the actual teaching and learning process, with their taking the principal role in the process and the teacher being a mediator; democratic participation in conflict resolution and classroom decision-making is promoted

(continued)

Table 2 (continued)

Student		
Main dialogic axis	Secondary dialogic axes	Indicators
	Socio-environmental reality, Unintegrated↔Integrated	1. The socio-environmental reality is not reflected in the development of the classes, and therefore is not linked with the students' future professional role 2. The socio-environmental reality is sometimes linked with the students' future professional role 3. The socio-environmental reality is inherent in the role and professional development of the students, as is manifest in the classes (through discourse, activities, …)
	Classroom dynamics, Closed↔Open	1. No account is taken of the students' interests and concerns, only the initial planning 2. The students' interests are attended to, allowing time for reflection, but the proposals are not developed further 3. Students' proposals in relation to the formulation and treatment of problems, cross-cutting content, activities, etc., are taken up; the process is reorganized, and reflection on and analysis of the proposals is promoted in the dynamics of the class
	Class work, Individual↔Group	1. Individual work in class is the most widely used resource; group work is not part of the methodological strategies 2. Group work is sporadic; it is an insignificant methodological resource 3. Group work is significant and plays an important role in the process 4. Cooperative work is combined with individual work in the development of the classes, and both are significant in the teaching and learning process

Source The authors

The process of developing of HAMS has triggered profound reflections throughout the entire investigation inherent to the qualitative research methodology.

Specifically, the different types of gradient have hindered the analysis of data. In addition, the results for each one of the three agents that make up the system of the classroom—teacher, student, and content, cannot be considered separately. Any action in the classroom is associated with the interactions between three agents. These interactions show the level of inclusion of sustainability in the teaching-learning process. This question has constrained data analysis process and the interpretation of the achieved results.

Table 3 The main dialogic axis, secondary dialogic axes, and indicators for the teacher as agent

Content		
Main dialogic axis	Secondary dialogic axes	Indicators
Planning	Teacher-student relationship, Vertical↔Horizontal	1. The content is presented in a closed form, organized by topics that match the organization of the discipline 2. The content is grouped into thematic units, and these are the main objective of the process, but small spaces are allowed for the treatment of other content of interest 3. The content has a common thread, it is not set in stone but is open to the incorporation of new topics arising in the teaching and learning process 4. The content has a common thread that responds to the resolution of problems proposed in class; it is not an end in itself, but is open to the incorporation of new topics 5. Apart from not being an end in itself, from having a common thread, from responding to the resolution of problems, and from being open to the incorporation of new topics, the content also incorporates the strategies developed in the teaching and learning process
	Competencies, Specific↔Transversal	1. The competencies only refer to the use of the knowledge and content corresponding to the subject 2. The competencies interrelate different types of knowledge 3. In the planning, the development of transversal competencies is introduced as part of the knowledge
	Socio-environmental reality, Unintegrated↔Integrated	1. The content is limited to that which is specific to the subject and included in the official curriculum of the degree 2. The subject's content contains some issues or aspects relating to the socio-environmental reality 3. The socio-environmental reality has a constant presence in the subject's content 4. The socio-environmental reality acts as the hub around which the course is designed
	Evaluation, Accreditation↔Procedural	1. The planned evaluation focuses on conceptual knowledge and on the student 2. The planned evaluation considers some other aspects of the teaching and learning process in addition to knowledge, but its focus is only on the student 3. The planned evaluation takes into account all elements of the teaching and learning process; also, the programming specifies the evaluation criteria

(continued)

Table 3 (continued)

Content		
Main dialogic axis	Secondary dialogic axes	Indicators
Intervention	Teacher-student relationship, Vertical↔Horizontal	1. In class, the programmed content is worked on in a linear and systematic form, setting the pattern of the class dynamics 2. The content is treated systematically, but it is also worked on as providing tools for solving situations and finding information 3. The content in class is at the service of solving problems, and itself becomes a resource
	Socio-environmental reality, Unintegrated↔Integrated	1. When the content is covered, only knowledge corresponding to the subject is worked on 2. In addition to knowledge corresponding to the subject, aspects that do not strictly correspond to the discipline and with reference to the socio-environmental reality are dealt with sporadically 3. Knowledge from other areas or disciplines is addressed transversally in a form underlain and articulated by the socio-environmental reality
	Resources, Internal↔External	1. No socio-environmental issues are used to address the content 2. Reference is made to such issues, but they are not used as a resource with which to work on the content 3. Real cases are used in which to involve the content, making references to current issues (the content is thereby given applicability)
	Classroom dynamics, Closed↔Open	1. The questions/strategies used in class are final, and seek only to reaffirm the content being taught 2. New questions are opened to encourage the students' reflection, but their responses are not used as a strategy to approach the content 3. The questions/strategies formulated are open, with a dynamics in which the responses themselves become content, and are further enhanced and built on

4 Conclusions

We must move towards models of the university that promote a harmonious relationship between society and the biosphere, and which form citizens and professionals capable of meeting this challenge. For this, it is necessary to include ESD in university classes through using methods that favour its principles. The research conducted has led to identify some methodological strategies as a possible way to work towards this end.

However, we assume that the path for this inclusion is not generalizable, but instead demands inquiry, reflection, and experimentation appropriate for the process in each specific case. It is not a proposal for immediate and final implementation, but part of a long-term constructive process. Our goal is to provide keys, to put forward a starting point from which each teacher can construct their own personal and transitory route which will increase in complexity as they progress in integrating sustainability in their classes. To help with this process, we presented HAMS, a system of categories for data analysis, which may be of use to analyse and reflect on teaching practice. It is a powerful means of methodological self-diagnosis for teachers interested in this area, since it lets them detect their own actions and decisions, and offers them options that can foster an appropriate ESD.

We believe in the future HAMS can also serve as a tool with which to analyse the curricula of institutions of higher education, and to determine the degree to which they include sustainability. It can also be a means of support for university authorities to plan and design educational activities that result in improving the impact of sustainability in their institutions. HAMS can begin a transition road from a simplifying view of action in the classroom to a complex view which is in accordance with the principles and values of sustainability (Wals and Jickling 2002).

To conclude, we believe that both HAMS and the methodological strategies can serve to inspire the adoption of similar approaches, and for the university community to share methodological practices that can contribute to extending the culture of sustainability. Assisting university teaching staff to recognize their actions and the possible changes they might make in their practices is a real way to achieve systemic changes (Barth and Rieckmann 2012). They are the ones who can act as facilitators of learning for ESD, and therefore equip their students with the competencies that they in turn will need to contribute to sustainable development.

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Controlling Risks Through Flexibility and Urban Integration: The Regeneration of Otaniemi Campus in Finland

Antti Ahlava, Jarmo Suominen and Saana Rossi

Abstract

Aligning Aalto University's scientific and economic potential and risk management with the growing Otaniemi campus takes place with flexible and integrative spatial and urban concepts. The campus development wants to maximize the usages of existing resources, optimize the flexibility of uses and minimize fixed costs of users for changing future as well as to produce urban, street-level places for enhanced social encounters and open innovation. This living laboratory of campus development aims at flexibility also in energy production, as well as at increasing self-sufficiency, made possible by local energy solutions, a smart utilization of electricity network and by changing consumer behaviour. The new internal service operator role for renting relevant resources has diminished surplus areas of academic units and the freed spaces are treated as shared resources for work, housing and services according to the principle of Building as a Service (BaaS). New types of gardens support biodiversity cycles. The university has also implemented on-demand public transportation service supporting flexible mobility to other campuses. The campus sustainability programme connects the university with external partners, such as industry, government, and various organisations of civil society. Through this

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