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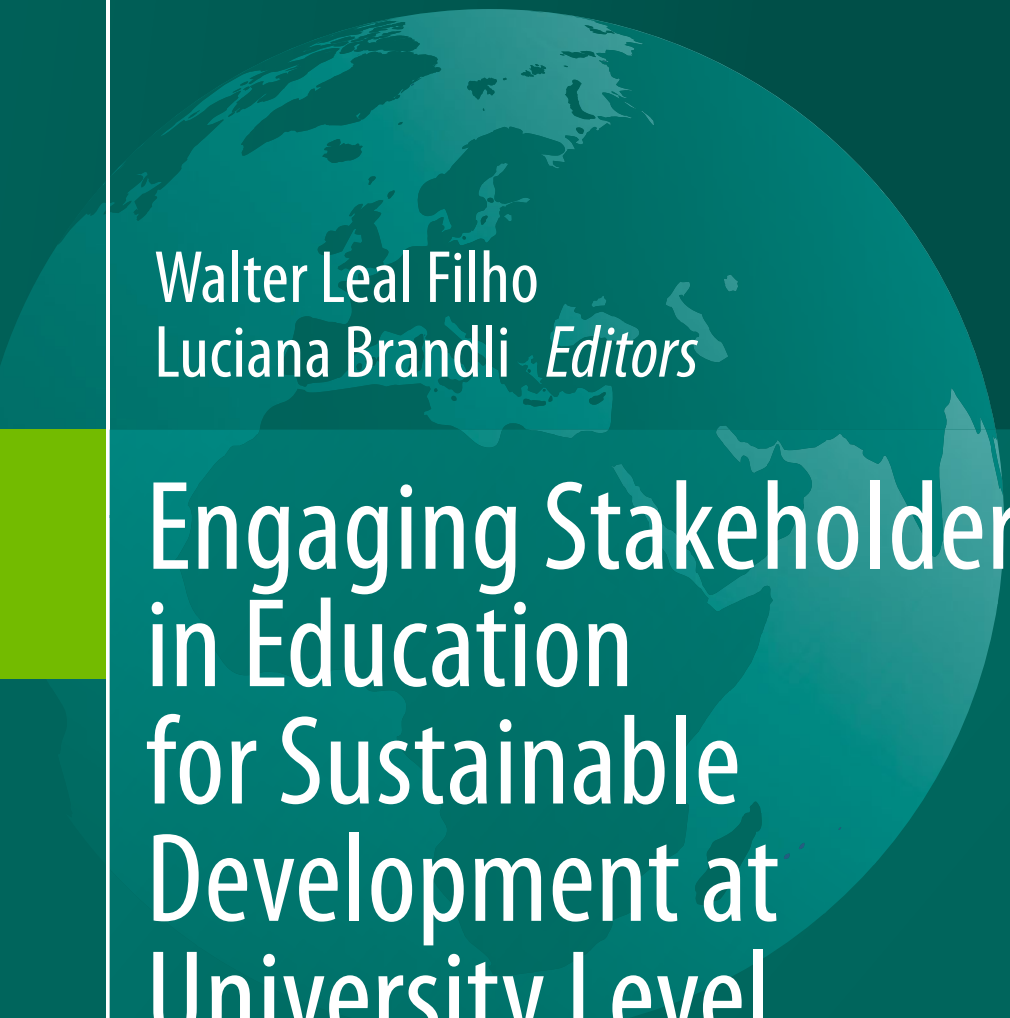

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Engaging Stakeholders in Education for Sustainable Development at University Level

Springer

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Engaging Stakeholders in Education for Sustainable Development at University Level

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Preface

It is well known that, in order to yield full results, urbanisation and city development need to be pursued within a sustainability framework. Unsustainable urbanisation may lead to low levels of life quality, may cause social injustice, compromise environmental equity and endanger growth as a whole. Sustainable cities and societies are characterised by a common planning and management vision that promotes things such as the use of green spaces, the use of public transportation systems, waste prevention and sustainable energy use, among others. Also, public and private partnerships can be useful in creating sustainable and livable communities, which pay equal emphasis to their historic, cultural and environmental resources.

The goal of this book, whose focus is on the engagement of stakeholders on matters related to sustainable development, was to fill in a gap in the literature of publications, which specifically focus on the contributions of individuals and organisations in realising sustainable development objectives and goals.

Readers will be able to draw the knowledge and experiences from the authors, whose diverse work illustrates the wide range of approaches and methods which can be used, in order to foster the engagement of various stakeholders in sustainability efforts.

This book is structured into two parts. Part I focuses on the engaging stakeholders on sustainability issues. It presents a wide range of perspectives. In the Chapter "Creating a Sustainable Learning District by Integrating Different Stakeholders' Needs. Methodology and Results from the University of Cantabria Campus Master Plan", experiences from attempts to create a sustainable learning district by integrating different stakeholders' needs in Spain are presented.

In the second chapter, the "Built Environment Sustainability and Quality of Life (BESQoL) Assessment Methodology" is introduced. In the Chapter "Contributing Towards More Sustainable Cities—Learning Through Collaboration", a presentation of "Methodological Approach Developed for the Collaborative Learning Process to Contributing Towards more Sustainable Cities" is made. The Chapter "Campus Sustainability: Does Student Engagement with Eco-Campus Environmental Activities and Green Initiatives Really Matter?" is concerned with "Student Engagement with Eco-Campus Environmental Activities and Green Initiatives", whereas the Chapter "Supporting Grassroots-Led Initiatives in the Spanish

Energy Field Through Transformative Education for Sustainable Development" approaches "an Experience in Spain about Grassroots-led Initiatives in Energy Field through Transformative Education for Sustainable Development". The sixth chapter deals with "An Integrative Framework for Re-thinking 2nd Generation Sustainable Development (SD2.0) Projects, Education and the University as Catalyst", and three illustrative examples of SD2.0 work are given. The Chapter "Student Work Placements as a Focus for Building Partnerships Between Universities and Sustainable Development Stakeholders" describes "key methods of engagement by Northumbria University's Geography department with their partner organisations in the context of a workplacement module, including the way that students are selected, placed, coached and assessed". The Chapter "The Role of Education for Sustainable Development in Maltese Marine Protected Areas: A Qualitative Study" has a focus on "The Role of Education for Sustainable Development in Maltese Marine Protected Areas (MPAs), exploring the perceptions of key stakeholders with regards to the current state of play surrounding MPAs and ESD as well as its future direction". The Chapter "Educational Landscapes for Sustainable Development in Cities. Actors, Structures and Processes in Osnabrück" emphasises "Educational Landscapes for Sustainable Development in Cities discussing the role of actors, structures and processes in Osnabrück". The tenth chapter looks at the "Involvement of Advanced Level Students Using Ecological Modelling in Research About Regional Sustainability".

Part II of the book focuses on the case studies from universities, where the engagement of internal and external stakeholders is emphasised. In the Chapter "Aligning Goals for Sustainable Outcomes: Case Study of a University Building in Australia", an emphasis is given to "Aligning Goals for Sustainable Outcomes showing a Case Study with key stakeholders involved across the design, construction and occupation of the university building in Melbourne, Australia". In the Chapter "Science-Society Interfaces—Transforming Universities", the authors focus on the potential of RCEs to foster more sustainability-oriented pedagogic approaches. In the thirteenth chapter, a presentation of "The Role of Students in the Co-creation of Transformational Knowledge and Sustainability Experiments: Experiences from Sweden, Japan and the USA" is shown. The Chapter "Transition to Transformation in Fashion Education for Sustainability" is concerned with the engagement of stakeholders in fashion ESD and introduces a co-created curriculum between a world leading company Kering, in partnership with a globally reaching educator, London College of Fashion (LCF) at the University of the Arts, London (UAL). The fifteenth chapter approaches "The Great Problems Seminars: Connecting Students with External Stakeholders in Project-Based Approaches to Sustainable Development Education in the First Year". The Chapter "The Role of Solution-Oriented Knowledge Transfer Programme and Networking in Charting a New Course in University-Stakeholder Engagement" deals with "one knowledge transfer programme partnership involving 'university-industry/community', and four specific 'network' initiatives designed to promote university-stakeholder engagement at a variety of levels" and the Chapter "Engineering Education for Sustainable Development in Malaysia: Student Stakeholders Perspectives on the

Integration of Holistic Sustainability Competences Within Undergraduate Engineering Programmes" describes Student stakeholders perspectives on sustainable development competences they deem as important to enable them to become sustainability competent engineers when they graduate, in Malaysia.

The Chapter "University, Environmental Education and Community Engagement for Sustainable Development: A Study of the *Horta Escolar* Project, University of Southern Santa Catarina, Brazil" has a focus on "University, Environmental Education and Community Engagement for Sustainable Development and presents the Horta Escolar Project, which aims to promote awareness of environmental conservation through sustainable practices in food production". The Chapter "Student Capital in Green Cities: Building University—Student—City Coalitions" emphasises "Student Capital in Green Cities showing a project that is testing different ways for securing student engagement in transforming sustainability activity in the city region—in partnership with the business, public and voluntary sectors", and the Chapter "ZukunftGestalten@HM—Future City. Transdisciplinary Approach Combining Higher Education for Sustainable Development and Designing the Future of the City of Munich in an Urban Real Lab Case" looks at an innovative course format 'ZukunftGestalten@HM—Future City' at the Munich University of Applied Sciences (MUAS), including its unique features from a higher educational perspective for sustainable development (ESD). The Chapter "Engaging Stakeholders for Sustainable Development" discusses the extent to which such an engagement takes places, draws some parallel between universities and companies, and outlines some of the limitations which prevent it from being more widely practiced.

We thank the authors for their willingness to share their knowledge, know-how and experiences, and hope that the content gathered here supports current and future efforts towards realising the potential of engaging stakeholders in sustainable development issues all over the world.

Enjoy your reading!

Winter 2015/2016

Walter Leal Filho
Luciana Brandli

Contents

Part I
Engaging Stakeholders

Creating a Sustainable Learning District by Integrating Different Stakeholders' Needs. Methodology and Results from the University of Cantabria Campus Master Plan

Cecilia Ribalaygua Batalla and Francisco García Sánchez

Abstract

Higher education campuses are seen as one of society's valuable resources for facing sustainability challenges in the urban context. However, one of the main challenges in the design of sustainable and liveable campus is to achieve comprehensive planning schemes that ensure the commitment of the Master Plan to the stakeholders. The paper reviews a specific methodology built on an inter-disciplinary approach basis, which includes a public participation process for creating a model of sustainable campus at the University of Cantabria, Spain. Traditionally, strategic planning on university campuses has been based on limited sectorial perspectives, which should be modified in order to meet new goals outlined in "The People's Sustainability Treaty on Higher Education". With traditional planning methods, stakeholders' contribution is reduced to the participation of meetings where common intentions are declared. However, coordination with stakeholders in the process must be more tangible and accountable through documents approved by both parties. The article analyses the effectiveness of a Campus Planning methodology through the review of the commitments agreed in common (public documents approved by stakeholders), crossing them with concrete measures designated at the Master Plan. This

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experience has shown how the effort in an urban design based on compromises with stakeholders and public participation can achieve the proposed objectives of sustainability and other common objectives in coordination with local and national stakeholders.

Keywords
Sustainability · Higher education · Urban planning · University campus · Master plan · Social learning spaces

1 Introduction

Awareness of the need for more balanced and sustainable development is increasingly present in the governance of the city and, within it, university campuses are no exception in this dynamic. The role of stakeholders is clue since they need to be engaged in this process of education for sustainable development at Universities in order to make it successful. In this process of integrating stakeholders, drivers of sustainability in higher education can contribute to the development of sustainability initiatives and partnerships (Bilodeau et al. 2014).

One of the main challenges in the design of sustainable and liveable campus is to achieve comprehensive planning schemes that ensure the commitment of the Master Plan to the stakeholders. Although there has been much developed under holistic approaches there is a need of specific tools that allow validating engagement of stakeholders in the planning process, as stated by Disterherft et al. (2015). There is also a need of a common framework and a specific tool with a common terminology (León-Fernández and Domínguez-Vilches 2015). The work exposed in this paper aims to meet those needs of planning tools that allow the engagement of stakeholders in the process with an effective tool and specific protocols and terminology.

The purpose of the paper is to reflect on the effectiveness in engaging stakeholders of this specific Campus Master Plan methodology. This objective is pursued by reviewing all commitments agreed in common by stakeholders involved in the process, crossing them with concrete measures designated at the Master Plan.

Higher education can be seen as one of society's most important resources for facing its daily challenges, and sustainable development is one of the determining factors for the future (Fadeeva and Mochizuki 2010; Barth et al. 2011). In the last two decades, higher education institutions, from America to Australia, from Japan to Europe, have been incorporating new sustainability strategies in their plans and programs, with more than a thousand universities committed to sustainability goals (Waas et al. 2012). This change is also a demand of students, who are concerned about developing academically in sustainable environments (Bone and Agombar 2011). This demand of sustainability aspects was proved by White (2014) in his study on American campuses, concluding that these environmental characteristics are more prominent than social equity aspects in the campus sustainability plans.

Within higher education, in the field of sustainable management, sustainability certifications (Saadatian et al. 2011) have emerged. In this sense, the tried and tested LEED, BREEAM or "Sustainability Tracking and Assessment Rating System" STARS, have proved to be useful tools in the process of assessing the degree of sustainability. However, these certifications do not reflect a key issue, namely participation in these processes of different stakeholders, with comprehensive and inclusive procedures, which must be led by the university (Ryan et al. 2010). In a global context of international agreements and conferences committed to sustainability, we can highlight the People's Sustainability Treaty on Higher Education (Copernicus Alliance 2012), which in its fourth principle incorporates sustainable development as a process of learning in itself.

The English-speaking world's tradition of designing college campuses, with social spaces oriented to learning and staging university life developed a theoretical model easily identifiable in the literature (Turner 1984; Gumprecht 2007; Haar 2011). Strange and Banning (2001) set out a thorough reflection on the criteria that should govern the construction of a campus promoting "academic success". The campus design should consider values such as the level of security, participation, establishing a community of "learners", while integrating new technologies.

The integration of this tradition of green campus with the principles of sustainability occurred gradually over the last century (Dober 2000; Strange and Banning 2001; Chapman 2006; Coulson et al. 2011). Dober (2000) distinguishes among the conditioning elements (climate, vegetation, geotechnical issues, programs and funding opportunities, etc.) and items that can/should be designed homogeneously within the campus, as well as specific design criteria (environment, perimeter, entrances/exits, walking paths, bicycle lanes, plazas, etc.). Although nowadays green spaces on campus are still treated differentially, and not in an integrated way, we are eliminating merely ornamental considerations and providing uses and functions (Gaines 1991; Gobierno de España 2010), which are specific for each green area on campus in line with sustainability criteria.

Spanish Universities are undergoing a process of transformation toward Campuses of International Excellence, based on improving the quality of teaching, research and knowledge transfer. The program pursuits "transformation of the campus into real knowledge environments, where quality of life, environmental sustainability, strategic aggregation of agents and institutions, (…) urban planning and the concept of social and educational campus are examples of excellence at international level", as said at the Campus of International Excellence Work Program (Campos Calvo-Sotelo 2010).

The physical support of the campus therefore should also pursue excellence in its formal and informal settings. The transformation of the campus in a sustainable environment, both in the urban concept of its open spaces and the use of its facilities, is part of the strategic objectives of the University of Cantabria, contained in the document "Theoretical and Strategic bases for the Promotion of Agenda 21" (Universidad de Cantabria 2009a) and the "Cantabria International Campus" Project (Universidad de Cantabria 2009b, 2009c).

The University of Cantabria is a public university located in the northern region of Cantabria, Spain. It was founded in 1972 and is organized in 15 schools and colleges, spread in three areas (Santander, Torrelavega and Comillas), giving higher education to more than 14,000 students. In 1970 the City and Province Council of Santander gave the grounds of Las Llamas to create a campus of 118,000 m^2 for the new university. In 2014 this surface has been expanded in 62,000 m^2 and integrates 620,000 m^2 of park (Las Llamas Park), which becomes one of the strategic elements in the Master Plan.

The UC is also a social, cultural and economic energizer in the autonomous region of Cantabria. The University collaborates with the main public and private agents within the social and economic environment of the region, through the strategic project "Cantabria International Campus". This regional role is not a rare case, since, as stated by De Sousa (2015), "urban universities are perfectly situated to be engaged in productive community higher education partnerships that add value to students, faculty and the communities in which they are located".

In accordance with the eighth principle of the People's Sustainability Treaty on Higher Education (2012), the UC accepts sustainable development as a systemic commitment of the institution, thus integrated into the processes of governance and decision-making in an open, transparent way, and based on participation. Faced with the challenge of designing a comprehensive and inclusive plan, which allows a sustainable governance of the campus, a new tool has been designed. The aim of this Plan is to unify in one document the wishes and commitments shared by all the university stakeholders, with participation from its students and workers.

The Master Plan is designed as an integrative tool, as opposed to the previous tradition of sector-by-sector urban planning, establishing direct involvement of all stakeholders in the future of the campus. The involvement of stakeholders is itself an effective tool in integrating sustainability criteria, since a proactive approach in management is essential to ensure the success of the integration effort (Abdul Nifa et al. 2014).

The starting thesis of the Plan, and this article, is that the participation of stakeholders in the process is not merely a statement of intent, or participation in a series of sessions, but should be incorporated in document's guidelines. Therefore, common commitments are defined (found in the documents subscribed by all, such as plans, agreements, criteria, etc.), and then checked whether each of those commitments has resulted in an action or strategy of the Master Plan.

2 Design of an Integral and Innovative Method of Governance: The Santander Campus Master Plan

The Master Plan of Las Llamas Campus (Garcia and Ribalaygua 2013) was initiated in 2011 with the aim of reconciling sustainability commitments made in the Local Agenda 21 Santander City Council and the Cantabria International Campus

Program. Priority aspects of other references and regulations were also adopted. All these commitments were incorporated into the "framework documentation" which provided the theoretical basis of the Master Plan, which focuses in three key areas: Sustainability; Urban Quality and Creation of outdoor Social Learning Spaces.

The objective of the Master Plan analysed in this paper is the proposal of an integral and inclusive model of campus that responds through specific measures to the criteria recommended in these ***framework documents***. With this approach, and after ***cross-sector studies***, analysed transversally to obtain an integrated diagnosis, five major ***planning principles*** are proposed allowing the grouping diversity of proposals.

2.1 Master Plan Elaboration Process: Integrating Stakeholders Needs

The process is divided into 4 phases, and brings together more than a dozen stakeholders. Each phase corresponds to a different stage in the development, and stakeholder engagement occurs seeking different objectives and addressing the problem from different degrees of detail (see Fig. 1).

While the first phase focuses on the contribution in main objectives of the Plan (thereby specifying which aspects should be focused) in order to define an *Initial Draft*, the second phase incorporates the common commitments stakeholders' documents (local and national). This participation, along with other specific studies, define the planning principles and strategie*s* of the *Preliminary Document.* On the basis of this document, the third phase will be focused on discussing specific

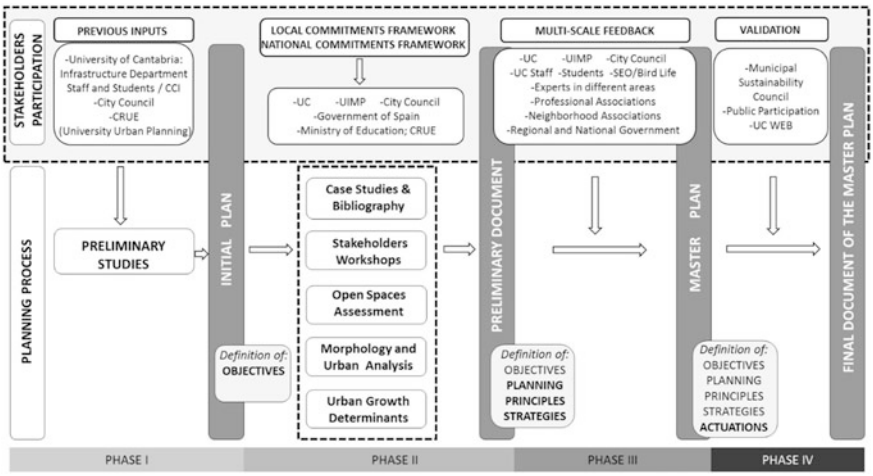

Fig. 1 The Master Plan elaboration process

strategies included in it and define the actuations to be carried out through workshops conducted with over a dozen stakeholders.

The final phase allows all citizens to review the *Master Plan* and provide suggestions and modifications both directly with citizens (public display in public spaces in the city and via web) or through representative bodies. Finally, the *Final Document* was approved by the Governing Council of the University and the Municipal Sustainability Council between 2012 and 2013.

After detecting main objectives in order to define an *Initial Plan*, different studies have been developed for detecting potential strengths and opportunities in the campus open spaces. The study and cataloguing of green spaces and their flora, or the analysis of urban and territorial structure have been reviewed, focusing on both the "micro" and "Macro" contexts. The Plan also considered variables such as the incidence of the weather, the study of sunlight, topography or accessibility. Although the studies were carried out focusing on sectors, in both their approach and the assessment of results, a multidisciplinary perspective has been developed in order to reach solutions that will integrate both functionality and environmental quality.

The processing of the Master Plan counted on the participation of different agents who introduced specific requirements to make the campus an exemplary model of sustainability. The main stakeholder in the process was Santander City Council. In 2011, the various meetings held enabled consensus to be reached among the strategic objectives and the specific strategies and actuations. Once the document was completed, a new phase of consultation was carried out with all areas of the City Hall (April 2012) to incorporate very specific actuations.

The Menéndez Pelayo International University, a private institution with which there is already an alliance through the Cantabria International Campus project, whose small campus is located next to the University of Cantabria, is involved ensuring compliance with the strategic guidelines feedback.

The participation of different university groups (such as students, docents, specific administrative staff, academic responsible, cultural and social services, etc.) in drafting the Master Plan was carried out in two phases (I and III in Fig. 1). Together with this collective, neighbours associations of the area were incorporated in the process, as another important stakeholder whose participation becomes key also in both phases:

In a first phase, the workshops organized, together with the initial field work, enabled a diagnosis of the problems, threats, weaknesses and potential of the campus. This initial diagnosis also included peer-to-peer discussion on surveys carried out beforehand in which the value that students give to the social spaces (DEGW 2010) stood out. In this phase, the key elements of sustainable development to be incorporated into the final proposal were identify. The other participation phase was based on the Preliminary Document (phase III). The document explicitly defined both the planning principles and the strategies proposed. This level of detail

allowed not only discussing policy proposals, but also sounding out specific solutions, requiring only subsequent technical definitions.[1]

Together with this, and with the intention of enriching and reviewing the degree of fulfilment of the objectives of the plan, external experts have participated. These agents are involved in the planning of university spaces or related to key issues of the plan such as sustainability, mobility, Urban Planning for University or urban revitalization strategies, visual communication or the Santander Smart City programme. The ideas provided have enriched the document greatly, sometimes adding a strategic vision and on other occasions contributing, from their specialization, to fulfilling the objectives set out by the Plan in different areas.

2.2 Definition of the Master Plan Proposal

All previous aspects were integrated into the diagnosis, reviewed after public discussion of the document, and they form part of the final proposal that defines a model of campus based on five planning principles:

Social Learning Campus: Creation of a sustainable network of open spaces
In response to current shortages, and exploiting the potential of the existing infrastructures, a network of open spaces around two longitudinal axes has been proposed. Linked to these axes, open spaces are created with different orientations and sizes that encourage interaction between campus and city, following bioclimatic and functional criteria.

Integral Campus: Combination of new university uses
A model of global campus is proposed inviting the joint and interactive use of university space. To encourage successive use of the campus throughout the day and week a mixed-use model is proposed, so that a predominantly residential use is made of services intended for society. The "sustainable" residential district (Eco-district), aimed by the municipality, must be exemplary in integrating bioclimatic variables and adapting to the topography and local landscape. The integration of a new use of the spaces in the current campus will encourage interaction and centralize activity.

Accessible Campus: Campus of Sustainable Mobility
As well as bioclimatic criteria for locating and sizing open spaces, strategic planning of campus mobility is key. A "Zone 30" circulation model is proposed in which the motorized traffic template enables coexistence of the car with the bicycle. As a complement to these criteria, grouping of car parks is proposed to expand pedestrian areas as well as placement of suitable facilities for promoting the use of bicycles and public transport.

[1]The participation roundtables between November and December 2011 included the following groups: the Cantabria International Campus, the Infrastructure and technical advisors of the University, the Chancellor's Group, the Deans and Directors of Faculties, lecturers, student organizations and students, administrative and service staff, and surrounding neighbourhood associations.

Didactic Environmental Campus: Biodiversity and consolidation of botanic routes

In order to exploit the potential of green spaces in the campus it is proposed the creation of a university landscape that provides a backdrop to an educational botanic route. As this space is filled with college life, it will become a real landscape and will carry out the required teaching and exemplary role. To implement biodiversity and to fulfil the commitments of Agenda 21, guide criteria for planting and removal of species is proposed, as well as suitable sustainability criteria for taking care of the vegetation.

Campus Morphology: Creation of a campus landscape into its surroundings

Vegetation should also be used to consolidate identity, and a holistic image of the campus. The university grounds should no longer be an urban barrier and so it is proposed favouring the continuity of historical routes as well as the opening up of spaces for connection to the nearby park. The potential connection of the invaluable Parque de Las Llamas is exploited as far as possible through visual connections, establishing routes and viewpoints that contribute to this permeability.

2.3 Framework of Instruments for the Plan

The final planning tool of the campus (Fig. 2) is built upon the materialization of each of the five ***Planning Principles*** in different ***Strategies***. Each strategy will require one or more ***Actuations*** necessary to guarantee their achievement, which will be detailed in the final document of the Master Plan *Actuation Planning sheets.* These planning documents will specify the actuations to be undertaken, their location and the affected area, the necessary accompanying measures and the phase when the intervention is planned.

To complete the definition of the actuations the Plan will contain **Sector Actuation Guidelines**, as a complement to the *Actuation Planning sheets*. The objective of the Sector Actuation Guidelines is to indicate some general guidelines for implementing best practices in sustainability, homogenization of the campus identity and promotion of biodiversity.

The resulting *67 Actuations* (sorted by priority) have facilitated the use of the Master Plan itself as a document for daily management (roadmap of the Vice Chancellery of Spaces, Services and Sustainability), without losing the overall vision of the model. This scheme of governance ensures the effectiveness of strategic planning and ensures the preservation of the spirit of the strategies, irrespective of the final formalization of the proposals, which will subsequently be materialized in the corresponding detailed studies.

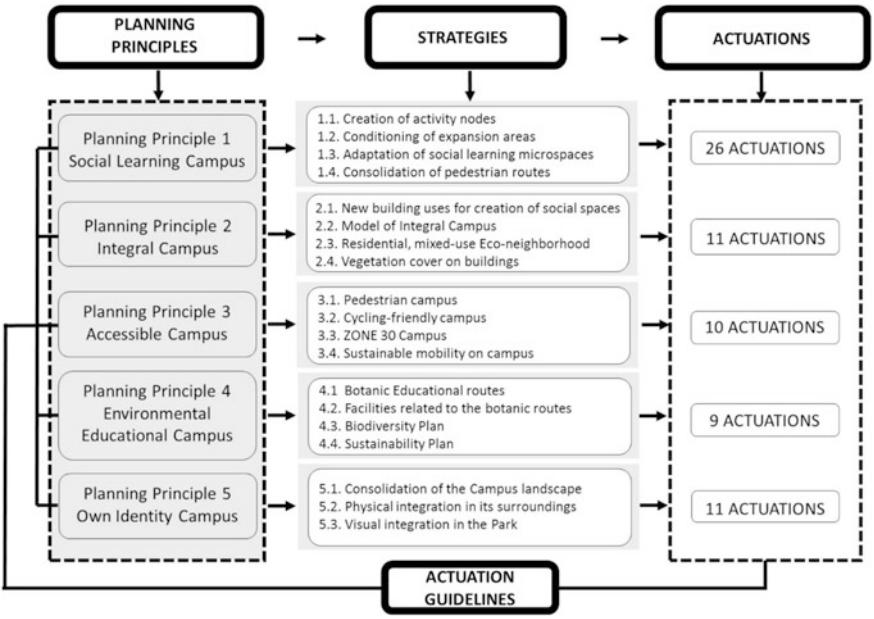

Fig. 2 General scheme of the structure of the Master Plan

3 Research Methods and Tools

In order to validate the effectiveness of the planning tool described above and ensure the commitment of the Master Plan to the stakeholders, verification tables are established with the mutual commitments. All Stakeholders highlight their priorities/wishes/ideas about campus sustainability in specific documents. The following tables identify both the stakeholders and the documents that serve as references to the mutual commitment between the University of Cantabria and each agent both in local (Table 1) and national level (Table 2).

By checking the volume of presence of the commitments made at the local and national level in the strategies, effectiveness of the planning model as a tool can be verified. In order to test this usefulness the following process is performed: First, each stakeholder documents are analysed, selecting all those requirements related with campus development; Secondly, a classification of these commitments based on their nature is made; finally, a cross-analysis with the strategies of the Master Plan is completed.

At the national level, four documents whose goals and commitments have been assumed by the University of Cantabria are essential. These documents incorporate broader perspective strategies (which do not address local documents so clearly) and force Campus Planning to integrate a clear urban sustainable vision (Table 2).

Table 1 Stakeholders and their respective documents for fulfilment at local level

Scale	Local	
Stakeholder	Document	Feature
Santander City Council + Seo-Bird Life Code: SANT 01	– Biodiversity conservation strategy	This document sets forth the basic strategies for conserving biodiversity in the municipal area. It sets out a blueprint for actions that are specified in objectives and actions aimed at the conservation of the environment in urban and rural settings
Santander City Council + Seo-Bird Life Code: SANT 02	– Action plan for parks and urban green areas in Santander: measures to conserve and enhance biodiversity	In line with the above document, the action plan introduces a set of guiding criteria and management measures to be applied in Santander's urban parks with the aim of conserving and increasing biodiversity
Santander City Council Code: SANT 03	– Santander Strategic Plan 2010–2020	This document incorporates the process of strategic planning to improve the organizational capacity of the city. It takes into account, therefore, those potential and unifying elements of the city that enable the establishment of actions in the future in a coordinated manner
University of Cantabria Code: UNICAN 01	– Theoretical and strategic bases for the promotion of Agenda 21 in the UC—Cantabria International Excellence Campus Program	The document promotes the implementation of a series of actions aimed at improving the environmental quality of the university as a whole. It reviews, in relation to the Local Agenda 21, the environmental context, identifying dysfunctions and corrective measures in the management of resources and waste, as well as in the biodiversity of the university area and the planning and conditioning of its spaces
Regional Government; Menéndez Pelayo International University; UC	– Cantabria International Excellence Campus Program	The Strategic Plan of the Cantabria Campus International, which integrates several stakeholders, aims to implement an integral model favouring the social, economic and cultural development. Since it belongs to UC itself this is the only document not included in validation

Table 2 Stakeholders and their respective documents for fulfilment at national level

Scale	National	
Stakeholder	Document	Feature
Government of Spain Code: GOVERN 01	– White paper on sustainability in Spanish Urban Planning	The document introduces basic aspects lacking in current planning for sustainability and energy efficiency. It specifies strategies for the transformation of the planning methods into a list of sustainability criteria favouring development in accordance with existing resources and contributing to more liveable spaces
Ministry of Education Code: GOVERN 02	– Spain, International Excellence Campus	The launch of the Campus of International Excellence initiative by the Ministry of Education in 2009 proposes the creation of synergies among different stakeholders that transcend the campus limits, under a University-City-Territory scheme
Conference of Chancellors of Spanish Universities (CRUE) Code: CRUE 01	– Report on University Urban Planning of the CRUE	The report argues for sustainability on university campuses and highlights the key role of the university as part of the system of decision makers at different scales. It also argues for the need for guidelines on planning of university spaces in line with the principles of sustainability. Among these, it highlights the educational role the campus should play
Conference of Chancellors of Spanish Universities Code: CRUE 02	– Assessment of the sustainability policy of Spanish Universities	Also within the CRUE, the Sustainability Assessment Group has worked since June 2007 on the project "*Evaluation of university sustainability policies as facilitators of development of the campuses of international excellence*", with the definition of a system of indicators to enable the assessment of university policies on sustainability

The research is limited to these sources, as well as the degree of compromise and specifications found in them. Some of the documents have a broad vision of sustainability and do not specify concrete actions or guidelines. The lack of this specification was assumed as part of the limitations of the work. In that sense, for the analyses of these paper only documents with specific guidelines or actions have

been selected. They can be very useful for inspiring the aim of the Master Plan, but cannot be part of the specific study that has been developed. A second limitation is related with private stakeholders, which do not subscribe guideline documents such as other public stakeholders. In this case we find too specific objectives that have also had to be discarded.

4 Results and Discussion

From the analysis of the commitments made in the documents of the national and local stakeholders, the degree of fulfilment is verified in the strategies of the Master Plan, grouped according to five key areas (*open spaces, uses, mobility, sustainability* and *morphology*). In this analysis, we recorded two types of results: The first are related to the characteristics of the strategies and actuations of the Plan itself and the inclusion of the educational factor for sustainability. The second are related to the validity of the planning model used as a tool able to incorporate the mutual commitments to stakeholders within its measures.

The first important finding is the presence of the sustainability factor in the urban planning of the campus' open spaces (see Table 3). Analysing the set of measures in the Master Plan, we found that the strategies for urban planning of open spaces under the criteria of sustainability and biodiversity entail about 51 % (PP1 + PP4) of all the developed strategies, while those related to diversification of *uses* represent 24 %; those concerning *mobility* around 13 % and those dedicated to urban *morphology* 12 %.

This predominance shows that the foremost aim of the Plan has been achieved effectively in creating sustainable social spaces and in fulfilling the objectives of biodiversity and sustainability education. These strategies correspond to 35 actuations (specific actuations of which 26 are for the management and production of open spaces and 9 are specific to education for sustainability).

This percentage of actuations related to open-space sustainability in the Plan is also consistent with the presence that this aspect has in the stakeholders' documents. The degree of fulfilment of such actuations represents 52 % of the times that the actuations of the various commitments are fulfilled (PP1 + PP4). It is therefore an aspect with a high degree of commitment in the Master Plan, although there are subtle differences that distinguish its degree of presence depending on the type of stakeholder (local or national) (Fig. 3).

In this differentiation depending on the scale it can be detected that the degree of fulfilment of the local stakeholders (City Council, university, neighbourhood, SEO-Bird Life) is basically in aspects related to biodiversity and sustainability, carrying out very specific actuations such as the creation of educational itineraries, especially concerning sustainability education (53.95 % of the local stakeholders' fulfilments). These are coincident aims of nearby entities, which find in the Master Plan an ideal tool for their implementation.

Table 3 Distribution of the degree of fulfilment of the strategies within each *Master Plan Planning Principle* in relation to the stakeholders' strategic documents

Master Plan Strategies	Planning Principle 1 (PP1)				Planning Principle 2 (PP2)				Planning Principle 3 (PP3)				Planning Principle 4 (PP4)				Planning Principle 5 (PP5)		
	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3
Documents at local level*																			
UNICAN 01	1	2	1	2	1	0	1	3	2	1	1	2	5	1	2	3	0	1	0
SANT 01	0	0	0	0	1	0	0	0	0	0	0	0	5	1	5	0	0	0	0
SANT 02	0	0	0	0	0	0	0	1	0	0	0	0	7	0	6	0	0	0	0
SANT 03	0	0	0	1	2	2	2	0	2	1	0	2	4	1	1	0	0	2	1
Total number of fulfilments	1	2	1	3	4	2	3	4	4	2	1	4	21	3	14	3	0	3	1
% of fulfilment (by Strategy)	1.32	2.63	1.32	3.95	5.26	2.63	3.95	5.26	5.26	2.63	1.32	5.26	27.63	3.95	18.42	3.95	0.00	3.95	1.32
% of fulfilment (by PP)	9.21				17.11				14.47				53.95				5.26		
Documents at national level*																			
CRUE 02	0	0	0	1	4	0	1	0	1	0	0	0	3	0	2	0	0	0	0
CRUE 01	1	0	0	1	2	2	4	0	0	0	0	0	1	0	0	0	1	2	1
GOVERN 02	1	1	1	1	1	1	0	1	0	0	0	0	2	0	1	1	1	2	2
GOVERN 01	4	3	5	1	5	3	2	3	5	3	1	2	6	1	1	3	2	3	3
Total number of fulfilments	6	4	6	4	12	6	7	4	6	3	1	2	12	1	4	4	4	7	6
% of fulfilment (by Strategy)	6.06	4.04	6.06	4.04	12.12	6.06	7.07	4.04	6.06	3.03	1.01	2.02	12.12	1.01	4.04	4.04	4.04	7.07	6.06
% of fulfilment (by PP)	20.20				29.29				12.12				21.21				17.17		
National + local level																			
Total number of fulfilments	7	6	7	7	16	8	10	8	10	5	2	6	33	4	18	7	4	10	7
% of fulfilment (by strategy)	4.00	3.43	4.00	4.00	9.14	4.57	5.71	4.57	5.71	2.86	1.14	3.43	18.86	2.29	10.29	4.00	2.29	5.71	4.00
% of fulfilment (by PP)	15.43				24.00				13.14				35.43				12.00		
Master Plan Actuations																			
Number of Actuations	3	5	9	9	3	4	1	3	3	3	3	1	3	4	1	1	5	4	2
Σ Number of Actuations	26				11				10				9				11		
% of Actuations (by PP)	38.81				16.42				14.93				13.43				16.42		

*Codes of the documents as defined on Tables 1 and 2

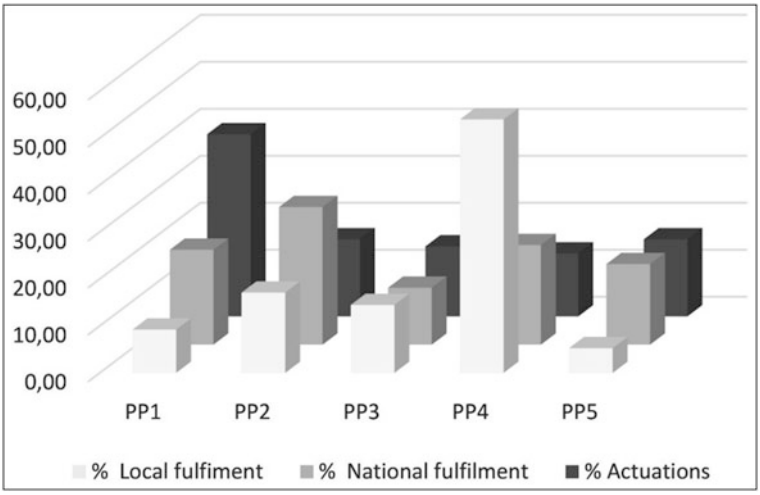

Fig. 3 Percentage of fulfilment of the documents and distribution of Actuations (by Planning Principles)

This is also due in part to the compromises set out in specific plans, which have been implemented in a proximate way, with the presence of SEO/Bird Life as a common link. The existence of this "linking" agent has enabled the integration of ideas in both senses (it was present both in the writing of the City Council's documents and in the Master Plan itself). The presence of this type of agent is key to good in integration of the different stakeholders' common actuations.

It should also be noted that this same aspect, although important for the set of national stakeholders, has not become so present (biodiversity/sustainability issues constitute 41 % (PP1 + PP4)). This situation is due in part to the greater distancing of the agents (the documents set out guidelines for action but not specific plans), but also to the lack of real presence of an agent that contributes to defining specific strategies rather than merely acceptable guidelines. With national stakeholders, however, appropriate criteria for open spaces are more clearly defined (20 %) as are those for distribution of applications (29 %), over 10 % more than what has been defined by local stakeholders. The scale of intervention, therefore, defines what kind of commitment is more or less suitable for or sensitive to each profile.

Finally, analysis of the data shows that there are some aspects that have a moderate degree of fulfilment in this type of planning tool. Issues such as mobility and urban morphology have a low percentage in the documents analysed (PP3: 13 %, PP5: 12 %). These are issues that need to be addressed with an integrated view, such as that of the Master Plan, but which require a different scale of planning for carrying them out.

In the case of mobility, the solutions must be approached from an urban scale, so it is not possible to carry out a large number of specific actuations (only 10 actuations, which is 6.7 % of the total), requiring the specification of a mobility plan on

a larger scale. In the case of urban morphology (focused on urban identity and integration) the measures are on the scale of an urban planning project, and are dealt with as an urban structure at city level, beyond the Campus scale.

These data also agree well with the data gathered about the participation of the university community in terms of its vision of the Campus. During the working sessions with the various groups, it was found that it was important to recover the open space as a place of relation as opposed to using this space for parking or purely ornamentally.

5 Conclusion

The work developed has practical implications in contemporary design processes of university campus engaging stakeholders. The tool described enables a high degree of fulfilment of the requirements commonly defined with stakeholders, as it uses reference documents that specify strategies and actuations to be integrated into the Master Plan. Besides the usefulness of the tool as a planning method, it has proved to be useful for coordinated governance with the different stakeholders and, therefore, an effective means of fulfilling the objectives.

Main findings of the study show evidences about the effectiveness and reliability of the planning tool developed, both in terms of scale and procedure:

- This planning scale is ideally placed for education for sustainability and integration into the urban and social fabric. In this way, the materialization of the principles contained in framework documents can be assimilated (national and local scales), which have until now not been transformed into specific actuations.
- The verification tool can be particularly effective for integrating shared commitments of the related stakeholders with education for sustainability and creation of sustainable spaces among their specific strategies and actuations (over 50 % of the Plan measures).
- The presence of "link—stakeholders", who take part in the planning of both the campus and the city itself, is clue. Their presence and technical collaboration guarantees both that there is coordination between the two institutions and that this is reflected not only in general principles but also in specific and coordinated actuations.

The tool analysed and presented in this paper can be replicable in different University Campus Master Plans, although each case must make it suitable to its context. In addition to this, the importance of using this methodology in both directions should also be highlighted. In this case study, over 200 agreements with local and national stakeholders have been taken into account, but it is necessary that this integration also occurs in the opposite direction. The creation of link agents, as mentioned above, but also of protocols and methodologies for integration of other agents must be performed from the top down.

Finally, it must be stated that outcomes reported are based on the identification of ideas/guidelines subscribed in several documents. This identification task has been performed by researchers. The reported outcomes have not been verified independently and have not either been possibly verified in reality, since it is a too contemporary Master Plan and projects are not built yet. Future studies might focus on this independent verification as well as in verifying real outcomes by checking consequences and not only planning ideas.

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Built Environment Sustainability and Quality of Life (BESQoL) Assessment Methodology

Paola Sassi

Abstract

The BESQoL (Built Environment Sustainability and Quality of Life) Assessment Methodology is a tool for professionals and students associated with the built environment designed to help develop sustainable low carbon developments that provide capabilities for a high quality of life for all members of the community. Developed as a teaching tool for postgraduate students of Oxford Brookes University's masters programme MSc Sustainable Building: Performance and Design, it has been applied to live built environment developments in the Oxfordshire area of the United Kingdom and in 2014 to two projects in Brazil in collaboration with local universities, stakeholders and professionals. The methodology involves a multidisciplinary and transdisciplinary approach involving experts from different disciplines and stakeholders associated with the area of development. The methodology includes examining five categories relevant to the development site: (1) the natural environment and natural capital, (2) the built environment, (3) movement, (4) economics, and (5) human capital and quality of life. By enabling a more holistic and informed approach to built environment developments through the application of the BESQoL assessment method, it is argued that students, professionals and local stakeholders (a) begin a transformative learning experience that addresses professional and personal values and can help refocus their professional contribution; (b) begin to understand the scope that needs to be addressed to create sustainable environments and learn to appreciate the relevance and importance of the various disciplines involved; and (c) are better placed to developed holistic and

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informed strategies that provide sustainable high quality of life solutions for all community members while impacting minimally on the local and global natural environments.

Keywords
Sustainability · Quality of life · Built environment · Higher education · Sustainability assessment method

1 Introduction

Creating sustainable futures requires considering multiple issues ranging from reducing carbon emissions to ensuring an economically viable future, protecting the natural environment and supporting human development. Passive low energy and low carbon measures and initiatives applied to the built environment have to be considered within their socio-economic context and in light of sustainability's aim to enable and support the positive growth of individuals, communities and countries. The main stakeholders in creating sustainable futures, the communities themselves, cannot be coerced in adopting sustainable lifestyles; they need to be offered a viable and attractive alternative to their current way of life that is also sustainable. Sustainability cannot be seen as a goal without concurrently considering quality of life.

The built environment has a role to play in creating capabilities for individuals and communities to attain a high quality of life and fulfil their potential for personal growth within the parameters of a sustainable and low carbon lifestyle. The built environment acts as the physical framework for living that can enable, for instance, a car-free existence, living in zero carbon comfortable and healthy buildings, and enjoying walkable neighbourhoods and green spaces. The built environment and the process of development can also encourage the creation or support of existing neighbourhood and support networks, help develop a sense of identity, and provide opportunities for training, education and employment (Sassi 2006). But as in relation to sustainable development in general, where it is increasingly clear that technological advances, legislation and policy frameworks are insufficient to create sustainable communities (UNESCO 2012a), the built environment contribution towards creating sustainable communities should ideally also support changes in mind-sets and values. Such changes could be triggered through educational experiences of developing sustainable communities and living sustainable lifestyles.

Education for sustainable development, whether directed at students, the public or professionals, has to therefore be more than teaching principles and potential solutions. "[In] its broadest sense, [it] is education for social transformation with the goal of creating more sustainable societies" (UNESCO 2012b: 33). The scope of issues to cover is broad-ranging from climate change and environmental issues to poverty reduction, and sustainable consumption (UNESCO 2012c). Furthermore,

within a constantly changing social context, education for sustainable development needs to equip individuals with the skills to develop sustainable solutions appropriate to changing scenarios, without knowing what these scenarios might be (UNESCO 2012b; Mila and Sanmarti 1999). As Tilbury (2011: 2) contends, "sustainability is more a journey than a checklist" and for built environment professionals and to some degree community stakeholders, the journey involves a process of enquiry, analysis and strategising well beyond the building envelop and developing new paradigms rather than accepting existing solutions.

Higher education is well understood as having a significant potential for introducing new paradigms, expanding individuals' world views, and providing students with the skills to address challenges of creating sustainable societies (UNESCO 2012a). However, education in the built environment sector, as in other sectors, often fails to address the existing mindset that limits the ability to address sustainability, by for instance segregating disciplines. It also addresses inadequately the breadth of issues that need to be considered when formulating strategies for sustainable developments (Tilbury 2011; Graham 2014; Warburton 2003) and often fails to address values and attitudes (Shephard 2008). Consequently, not only students but also many professionals often lack the awareness, knowledge and understanding of the fundamental characteristics of the built environment that contribute to sustainable lifestyles and developments. Education for sustainable development in higher education must therefore not only introduce new mindsets, but also reach out beyond the academic limits to the general public and professional to enhance their awareness and knowledge of sustainability.

A new paradigm of the built environment professional is needed. A paradigm that blurs the disciplinary boundaries allowing the professional to consider wider socio-economic and environmental aspects associated with the built environment. To achieve this a transformative education is required. As differentiated by Murray et al. (2014) from transmissive methods of learning, which provide information, the transformative process applied to built environmental professionals would require them to re-examine their professional role in the light of what they can contribute to creating more sustainable environments and communities.

It is therefore proposed that education for sustainable development in relation to the built environment, whether in an academic or professional setting, should aim to:

(a) support the removal of disciplinary barriers and facilitate a better understanding of the wide range of issues to address to achieve sustainable development, constituting the beginning of a transformative process;
(b) help learners to develop research skills and provide a framework for structuring such research, which can support learning within other disciplines as well as one's own;
(c) provide opportunities for multidisciplinary interaction and collective learning and opportunities for critical reflection of such experiences;
(d) provide opportunities for stakeholder interactions involving critically reflective listening, evaluating and responding to stakeholders' needs and aspirations and gaining their feedback on proposals;

(e) support the analysis, evaluation and synthesis of different strands of research and data collected for the purpose of formulating and presenting development strategies that respond to the environmental, economic and social context; and
(f) encourage a review of the role of the professional.

Furthermore, as advocated by the United Nations Decade of Education for Sustainable Development programme (UNESCO 2005), linking the educational initiatives to local communities will help develop public understanding and awareness, as well as providing students with an experience of a real life setting.

The Built Environment Sustainability and Quality of Life (BESQoL) assessment methodology aims to adopt a process-based teaching approach to address the above objectives. The following sections will outline the scope of the BESQoL assessment method, the way it addresses the above outlined educational aims, and evaluate its application in a number of settings.

2 Built Environment Sustainability and Quality of Life (BESQoL) Assessment Methodology—Background and Principles

The BESQoL assessment methodology is a tool for professionals and students associated with the built environment designed to help develop sustainable low carbon developments that provide capabilities for a high quality of life for all members of the community. The methodology was developed by the author as a research tool for postgraduate students of Oxford Brookes University's masters programme M.Sc. Sustainable Building: Performance and Design, and is applied in the research-led module, Sustainable Built Environments.

The tool was derived from a traditional site analysis and developed to include research into quality of life and economics and future visioning. Using the BESQoL assessment methodology, student participants in groups of five undertake comprehensive environmental and socio-economic research of the context of a site for development, which will also constitute the site for the students' individual design projects. The sites selected are 'live' in the sense that they are typically under consideration for development by the local authority, local residents' groups and or developers.

The aim of the assessment is to identify the needs of a community that relate to the built environment, as well as the strengths that exist and can be built on. The potential contribution of the built environment to creating or supporting sustainable communities is considered in its widest sense. This means that well-documented aspects of sustainable development, such as energy-, water- and material-efficient building and urban designs are researched, but also investigated are opportunities for addressing individual and community identity, encouraging social interaction, providing safe and secure environments, and supporting community and social networks. Relevant community stakeholders are invited to contribute to the research process. The assessment identifies and evaluates the status quo, envisages future developments and

changes, and after a detailed analysis proposes strategic development briefs that include development targets for sustainability. The BESQoL assessment results and proposed development briefs and strategies are presented to the community stakeholders and can inform the 'live' development. The briefs and strategies also form the basis for the students' individual architectural design proposals.

3 BESQoL Scope and Process of Assessment

The BESQoL multidisciplinary methodology examines five categories (Table 1) relevant to the development site: (1) the natural environment and natural capital, (2) the built environment, (3) movement, (4) economics, and (5) human capital and quality of life. The aim of the assessment is to identify (a) current status, (b) current needs and priorities, and (c) formulate strategies for the development. The categories were determined drawing from a number of sustainable design and development assessment systems and other relevant references including: Maslow's hierarchy of needs (1954), the OECD Framework to Measure the Progress of Societies (Hall et al. 2010), the BRE sustainability checklist for developments (Brownhill and Rao 2002), the SPeAR framework (Arup 2012), Building for life 12 (Collins and Quinn 2012), igloo footprint (Rossi 2012) and previous research undertaken by the author into over one hundred sustainable developments (Sassi 2006). The categories only include topics that either have an impact on the built environment or can be affected by the built environment, and participants can expand and amend the topics as required in response to the individual context.

The assessment methodology is introduced at the start of the process through a set of lectures and presentations from experts in the fields of building and urban design, urban food production, ecology, transport, economy and psychology. A conference format is used to encourage discussion and interaction between participants. Only once the fundamental principles are explained does the group visit the development site and on this occasion local groups with interests in the development site are invited to discuss their views with the participants.

The data collection is undertaken in groups of five to manage the quantity of data available and provide peer support during this learning stage. For each topic area the status quo is recorded, as well as historic developments that shed light on the current status and planned or expected future developments that would impact on the development in the future. Considering that built environment developments have decades and even centuries of potential life, it is essential for the planning of sustainable and long life developments to understand what the future is likely to bring, be it future climate change, population growth, demographic changes or technical innovation.

The data is collected by means of library and internet-based literature reviews of academic, grey and government literature; on-site measurements and observations; and surveys and questionnaires. Surveys and questionnaires are used to mimic a community consultation process and are particularly useful in identifying issues

Table 1 Assessment categories and topics. Italics denote categories and topics typically reviewed in a traditional project feasibility study and site analysis, which take place at the start of architectural developments

The natural environment and natural capital	The built environment	Movement	Economics	Human capital and quality of life
• *Site topography/land and soil quality* • Local geology/potential for use of local materials • Integrated agriculture and landscape • *Local macro/microclimate* • *Solar/wind/hydro/ground source heating and cooling and other potential sources of low carbon and renewable energy* • *Access to water and rainwater/site drainage/wastewater treatment & disposal* • *Conserving and improving local biodiversity/protected species and habitats/habitat connectivity* • *Waste disposal and composting*	• *Brownfield sites* • *Building uses existing* and required • *Urban density and grain* • *Quality of public, private and communal spaces/ legibility/townscape and visual character* • *Building stock characteristics (materials, character, height, scale and massing)* • Building stock performance (energy, water, material impacts, adaptability and maintenance) • *Secure and accessible environments* • Healthy environments (*light, noise,* pollution)	• Public transport infrastructure, connectivity, usability and quality of facilities • *Pedestrian facilities*, networks, *walkways design* and usability • *Cycle facilities* and networks, walkways design and usability • *Street design for inclusiveness* • Waterways as transport connections • Support for alternative transport e.g. electrical vehicle points • Car clubs, car sharing • Cycles rental schemes • *Parking for cars and cycles*	• Demographics existing and projected • Training and education • Existing skill-base, employment and businesses/contribution to local economy and sustainability • Employment and unemployment levels • Employment opportunities and creation, including during development process • Political framework to support economy • Social mobility • Access to finance • Access to and definition of affordable housing within the local economic context	• Access to housing, schools, retail, healthcare, employment and food growing opportunities • *Safe, secure* and healthy *environments* • Child-friendly environments • Physical and mental health • *Access to green spaces*, culture and leisure facilities for all age groups • Respecting socio-cultural-religious identities and opportunities for expressing group and personal identities • Community/social cohesion, engagement and interaction • Institutions and social networks

particular to the site and local community, investigating specific questions and collecting personal views from the local community and are typically found to be very helpful to the community stakeholders involved in the 'real' development.

In addition to collecting data about the development site, examples of good practice that relate to the areas are researched. Good practice examples from international settings may not always apply to the local context but can generate ideas and represent ideals that can inspire and help change fixed mindsets.

The data is presented in written, graphic and video form. For instance, the use of an existing carpark designated from future development might be recorded with video; surveyed in terms of use and then graphically represented with plans showing the number of cars every hour over a 24 h period; spatial quality might be illustrated with photographs; and user surveys may be represented in graphs with pertinent quotes to support the quantitative results. The data is then analysed in terms of (1) current status, (2) what should be done, (3) what can be done considering future political, economic or social plans and trends. The overall aim is to identify what the proposed development should include, remove or change to develop sustainable high quality of life solutions for all community members while impacting minimally on the local and global natural environments.

Using tools such as SWOT analysis and through group discussions, the analysis identifies a long-list of recommendations to prioritise. Prioritising strategies requires discussing values within the group and also considering the limits of impact and contribution the built environment can make. While the built environment can support a more sustainable lifestyle, it becomes clear to participants that the built environment is only one of a number of elements and mechanisms that can help to develop sustainable societies.

The research and analysis is summarised in a report, which includes supporting data and recommendations. The reports are made available to all stakeholders.

4 BESQoL Applications

The BESQoL assessment methodology has been applied to several live developments in the Oxford shire area. The most recent assessment was for the redevelopment of a redundant university building and adjacent car park in the Summertown area of Oxford. This redevelopment was under discussion by the local community, Oxford University and Oxford council. A local community group was formulating a Neighbourhood Plan, which constitutes a community-led framework for development, regeneration and conservation of an area. Representatives of the local group introduced the students to the site history, current use and future uses under discussion. They expressed their opinions about what should be included in the redevelopment and these views were noted and discussed. The students continued the exchange of views with the group and approached other members of the local community, such as retailers, staff from the local library and other community venues, as well as members of the public of all ages. The resulting assessment

reports were presented to the local group and a public exhibition was held of the assessment results as well as urban design and building proposals for the site. The local group used the research data to inform the Neighbourhood Plan and the public exhibition served to raise awareness public awareness of comprehensive sustainable solutions in general and for the site.

The previous year, the methodology was applied to a village north of Oxford looking for ideas on how to become more sustainable. On this occasion the design of a new sustainable community building was adopted by the community. The methodology is currently being applied to the North Gate development in north Oxford, which has attracted much local attention due to its extensive scope including commercial facilities and 500 new homes.

When applied by students at Oxford Brookes University the assessment was initially undertaken in a time period equivalent to ten days over a period of twelve weeks. In the last two years this period was reduced to four weeks. In 2014 the delivery period of the assessment methodology was further reduced when the Oxford Brookes University team was invited to run the BESQoL assessment methodology as an intensive workshop over 9 days at two universities in Brazil.

The first intensive workshop was run in Recife, where the city had appointed a consulting team associated with the Federal University of Pernambuco to develop a masterplan for a 30 km stretch of the Capibaribe River in Recife. The BESQoL workshop was supported by local ecologists, architects and urbanists, and was attended by local city council staff from the urban design and building departments. The requirement was to address the needs of local disadvantaged communities living along the river and the flora and fauna inhabiting the river side, while integrating a new transport link parallel to the river. Proposals were developed for smaller scale connectivity improvements, housing solutions and means to enhance the local identity and community cohesion. A second workshop was run in Porto Alegre and a third is planned also in Porto Alegre for the end of 2015.

The application of the BESQoL assessment by practitioners would involve broadening the scope of a traditional site analysis to include the BESQoL categories applicable to the development project under consideration. Not all categories may be relevant to all developments, and elements of the BESQoL assessment can also be cost-effectively included in community and stakeholder consultations, which are increasingly being commissioned by clients and councils in the UK. A competent professional may therefore require between two and seven additional work days to incorporate the additional BESQoL assessment elements into their standard scope of work.

5 Review of Teaching Methods and Learning Outcomes

The BESQoL methodology encompasses educational principles that are fundamentally important to sustainability education. It sets a framework for deep learning as defined by Warburton (2003: 45) who argues that “deep learning is particularly

crucial in the case of sustainability education, where holistic insight and an ability to organise and structure disparate types of information into a coherent whole is central to the whole exercise. Deep learning involves paying attention to the underlying meaning. It is associated with the use of analytic skills, cross referencing, imaginative reconstruction and independent thinking".

Deep learning is affected by prior knowledge and experience (Warburton 2003) and the first set of lectures delivered at the start of the assessment process, which adopt a traditional transmissive and disciplinary learning approach, are an attempt at levelling the knowledge starting point of all participants. The subsequent stages of the teaching and learning process aim to provide a transformative learning experience.

Following the introductory disciplinary lectures, the research stage adopts a number of the forms of transformative learning identified in the 2012 Report on the UN Decade of Education for Sustainable Development (UNESCO 2012a, b, c) as being associated with Education for Sustainable Development. The research process constitutes 'discovery learning' where participants are primarily self-motivated and become experts in their area of investigation. The participants bring their particular expertise to their working group and experience 'collaborative learning', whereby participants not only learn but also teach their peers. The diverse areas of investigation create an interdisciplinary learning experience and the interaction with community stakeholder brings an invaluable insight in non-professional views of built environment developments and sustainability. Finally the analysis of the different areas of investigation requires participants to adopt a critical thinking approach to views, values, data and proposals that the group develops and discusses. The development of proposals for the brief is effectively a problem-based learning process that requires applying systems thinking in the process of synthesising all the analysed data.

Participants in Oxford, Porto Alegre and Recife reported that they found the BESQoL workshops instructive and that they would use the assessment methodology in their future architectural work. In particular, they reported that the BESQoL methodology raised their awareness of the wider scope of issues affecting sustainability, a learning experience typically absent from disciplinary learning (Tilbury 2011; Graham 2014; Warburton 2003). They also reported that it gave them a better understanding of the role that the built environment has to play in creating sustainable environments that also offer a potential for a high quality of life. This new knowledge triggered some of the participants to reassess their role as built environment professionals. For instance, architecture graduates from Oxford Brookes University have progressed to professional posts and research degrees associated with sustainability in the built environment rather than design. Feedback from community stakeholder also suggests their participation and the research reports and exhibited designs raise awareness and open minds. While the assessment process is only one of many triggers for change, for both participants and recipients of the assessment reports, it supports a change of attitude by providing a structured framework for considering issues that are new to many.

Whether the change in attitudes translates into a long-term change in behaviour depends also on other factors including: personal values, opportunities and personal competences. According to Wals (2014: 12) generic sustainability competences include:

- Competence to think in a forward-looking manner, to deal with uncertainty, and with predictions, expectations and plans for the future.
- Competence to work in an interdisciplinary manner.
- Competence to see interconnections, interdependencies and relationships.
- Competence to achieve open-minded perception, trans-cultural understanding and cooperation.
- Participatory competence.
- Planning and implementation competence.
- Ability to feel empathy, sympathy and solidarity.
- Competence to motivate oneself and others.
- Competence to reflect in a distanced manner on individual and cultural concepts.

The workshop provides opportunities to develop some of the above competences, such as interdisciplinary working, but it cannot necessarily help participants develop the ability to feel empathy, sympathy or solidarity or motivate oneself and others. Some Oxford Brookes University students who participated in the workshop in their penultimate year of architectural education and fully embraced the approach, when faced with a lack of support for addressing sustainability in their final year, they abandoned the BESQoL methodology and reverted to a narrow discipline limited approach to their work. This also applied to some professionals employed in practices that did not have an active sustainability agenda.

It is human nature to conform to the norms of the community one inhabits. Perhaps one of the learning outcomes that could be added to the BESQoL workshop as well as Wals' (2014) list of sustainability competences is the ability to work within 'hostile' environments (environments that ignore or actively discourage addressing sustainably) and retain ones conviction despite lack of support. Education, discussions and debates can help formulate a clear personal position, but it is a value judgement that will dictate whether living consistent with a clear personal position is worth forfeiting other benefits.

6 Conclusion

The BESQoL assessment methodology is a tool designed to help develop sustainable low carbon developments that provide capabilities for a high quality of life for all members of the community. It provides a framework for considering, researching and addressing a wide range of issues that can be affected by or affect the built environment in terms of quality of life and sustainability.

Participants' learning outcomes suggest the methodology effectively raises awareness and knowledge of the wider sustainability and quality of life issues, and provides research, analytical, collaborative and problem-solving skills. The local stakeholders, including professionals and the community, benefit from the interaction with new and different approaches and ideas, as well as informative data and inspiring visual representations of sustainable developments and lifestyles.

The benefits of such educational initiatives on the sustainability of the built environment take a long time to come to fruition. The assessment methodology is a tool and it is the individual's choice whether to apply it. To make comprehensive quality of life and sustainability considerations mainstream either a critical mass of informed and dedicated individuals is required to make such approaches the norm (Ball 2005) or financial and legal instruments have to be employed. Financial and legal instruments are most expedient, but even though educational changes manifest themselves more slowly, they are long-lasting and also form the basis for successfully implementing any legal instrument.

Education relating to values is as important as any disciplinary and personal knowledge and skills in terms of providing individuals with the strength of conviction to act in contrast with the current norm, which while changing, will persist for some time to come. Gaining knowledge and understanding in relation to the underpinning of values is the first step towards changes in values and ultimately behaviour (Schwartz 1977). Strong values are difficult to sway and any educational programme needs to provide opportunities for individuals to gain new insight, such as that provided by the BESQoL assessment methodology, and form a strong foundation for their new values.

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Contributing Towards More Sustainable Cities—Learning Through Collaboration

Violeta Orlovic Lovren, Marija Maruna and Tijana Crncevic

Abstract

Purpose: In the year 2012 the Faculty of Architecture, University of Belgrade, initiated a new study program "Integrated Urbanism" at the master's degree level. The program was established in order to develop a new educational profile of urban professionals, integrating economic, social and environmental issues and creating a network of relevant stakeholders as a platform for collaborative learning. The aim of this paper is to present the methodological approach developed for the collaborative learning process that will occur while students participating in this program prepare their master's theses. *Methodology/ Approach*: The collaborative learning process is developed through the cooperation of students and mentors, the committee members, as well as with an external team of consultants from the most relevant institutions in spatial and urban planning and development in Serbia. The process was based on the platform of the "Integrated Urban Development Strategy for the Inner City of Kragujevac", a new instrument of sustainable urban development. *Results*: Based on that experience, students formulated thirteen master's theses, containing solutions for the implementation of selected individual measures that were defined in the Strategy,

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combining theoretical and practical knowledge gained within the program and the collaborative learning process. *Originality/value*: The orientation of the study program towards the establishment of a broad network of relevant stakeholders in the learning process, as a platform for student research and practical insights, provided a methodological approach of cooperation which can be applied in the future, by this and the other courses and faculties.

Keywords
Sustainable cities · Students · Collaborative learning · Integrated urban planning

1 Introduction

An increasing number of academic initiatives and scientific analysis reflect a response from universities around the world to global developments and goals for the future, oriented towards sustainability. Having in mind the ongoing processes of participatory development and discussions of the "Post 2015 Agenda", we may expect that global demands on universities will continue to grow, particularly in terms of their responsibility to nurture and enhance innovation and collaboration in the education process and build the capacities of students as agents of change.

Ensuring the quality and collaborative approaches in higher education, as promoted by relevant instruments such as Bologna (1999) and Gratz Declaration (2005) may be seen as naturally compatible principles to those embedded in the sustainability concept. These approaches may help all involved universities to open doors to sustainability, even if they exist in not quite favorable environments.

Recognizing these positive trends, we also observe a number of common as well as country specific obstacles today. As it was pointed out at the beginning of this millennia, "…sustainable development is the biggest challenge to universities in the twenty—first century." (Weenen 2000, p. 20). A recent analysis of the evolution of universities toward sustainability shows the best results in achievement from those academic institutions in which these principles are embedded into all the segments of their lives and, in particular, "…if a common vision is shared across the institution." (Leal Filho 2009, p. 319). At the same time, evidence shows that the best performing institutions operate in the developed countries of Western Europe, North America and Australia/Oceania (Ibid., p. 314).

In spite of the commitment to the concept and values of sustainability, as well as to modern requirements for teaching in higher education, the integration of sustainability into University of Belgrade is sharing challenges with other institutions in a country that has experienced recent turbulent political and social changes and longstanding economic transition. In such a complex environment, it is not surprising that, instead of a systematic integration of sustainability, there are rather sporadic initiatives by certain faculties, departments or individual teachers. As a result, there are positive examples of introducing new academic subjects into study

programs at faculties within all faculty profiles at the University of Belgrade, although they are rarely accompanied by other aspects of university sustainability (Orlovic-Lovren 2015).

The reform of higher education in Serbia in accordance with Bologna principles encouraged the diversification of study programs on different levels of study (undergraduate, master's, doctoral). It established a formal basis for the development and creation of new programs of study in accordance with the requirements of the development of the discipline and labor market needs (Law on Higher Education 2005; Rules on the Standards and Procedure of Accreditation of Higher Education Institutions and Study Programmes 2006; University of Belgrade 2006 2007a, 2007b; Faculty of Architecture 2006, 2008). Thus, the reform of the structure of higher education in accordance with Bologna principles formally imposed commitment of faculties to developing and improving curricula, thus slowely but substantially changing their traditional institutional framework and tendency to retain the status quo.

The faculty of Architecture within University of Belgrade is among the first institutions of higher education in Serbia that adopted a new model for studying at the bachelor and master's levels[1]. However, even though the new model has opened the possibility to introduce specialized profiles in the first round of accreditation under the new standards, primarly in the master's studies of architecture, the general profile of the architect's profession was retained with few hints of an interdisciplinary approach. The traditional form of educating architects prevailed, a universal profile characterized by practical experience and directed toward specific disciplines (planning, urban planning, design, construction) (Inženjerska komora Srbije 2012).[2] This approach introduced only a "mild" orientation within the general study of architecture at the master's level towards the realities of designers, urban planners and the technologies of architecture.

However, the political changes in Serbia in 2000, the transition to a democratic system and market economy as well an orientation towards the inclusion of the society within European and world trends are fundamentally changing the framework for action within planning. The newly created socio-economic context has led to changes within the concept of spatial interventions and influenced changes in the professional approach to spatial and urban planning. That has opened space to develop new knowledge and professional profiles that will be able to respond to the complex challenges of new practices in a country in transition and in accordance

[1]The reform of teaching was carried out within the EU TEMPUS programme managed by professors from European universities, with the support of their colleagues from the Faculty of Architecture. The TEMPUS programme is the EU programme that supports reform and modernisation of higher education in partner countries and one of the oldest and most successful programmes of cooperation with the EU.

[2]The connection to practical experience is firmly established through the process of obtaining the professional licenses issued by the national body of the Serbian Chamber of Engineers (Serbian Chamber of Engineers, 2012).

with contemporary trends in the education of urban planners that promotes interdisciplinary and integrated approaches from a sustainable development perspective.

The study program "Integrated Urbanism" at the master's level at the Faculty of Architecture of University of Belgrade, was initiated by the Faculty Urban Planning Department to develop a new educational profile of urban professionals. Founded on the sustainability concept, this initiative reflects the requirements and opportunities brought by the Bologna Declaration, as well as the needs of society for practitioners able to face the challenges and bring solutions to the complex issues of modern urban planning. In the light of the previously mentioned country obstacles and University challenges, this initiative represents much more than "sporadic change" or the introduction of a new subject. Building bridges across disciplines and between theory and practice, this new study program aims to overcome the previous traditional, "engineering" approach, break the barriers between the technical and social sciences and open the space for innovation, critical thinking and collaboration—all organic dimensions of modern learning and the sustainability concept.

The whole process of creating the curriculum was conducted by applying a participatory approach with the involvement and engagement of the vast majority of the members of the Department (Maruna and Milojkic 2014). After conducting the formal procedures and completing the process of accreditation, in the autumn 2012, the first generation of students enrolled. This established the first study program in the field of urban planning in Serbia.

In this paper, the applied methodological approach and the new Study program are not elaborated on in all the details and stages of its development. The central focus is on the process of collaboration. Though embedded in the Program at all stages—our particular aim is to present the process of collaborative learning of students participating in this program during the preparation of their master's theses.

2 Theoretical Framework and Methodological Approach to Development of the Study Program

Analyzing numerous discussions on the multidimensional concept of sustainability, the authors recognize two "generations of sustainability thinking": the first approaching sustainability as a future state or desired outcome, and the second emphasizing the process by which the goal of sustainability is reached, focusing on "…decision making, public engagement, collaboration, and deliberation…and attempting to reconcile them with urban sustainability's ecological, economic, and social components"(Robinson, in Leal Filho 2009, p. 110). By attempting to clarify terminology and better define terms often used as synonyms, others offer ways to consider sustainability as a goal, ideal and sustainable development as a process of achieving it (Scott, Gough, according to Orlovic-Lovren 2012).

Approaching urban planning from an integrated perspective, we think also in terms of a complex process, in which all steps or results might not be predefined. But isn't that so with sustainability as a whole? Uncertainty as a feature of modern times requires education at all its stages to develop the capacities of people of tomorrow to deal with visions and goals which are not predetermined and completely clear. If opening space for creative and critical thinking is among the possible answers to these requirements, then students of studies founded on the sustainability concept should have the freedom not only to choose the issues they are going to work on, but also to challenge existing approaches, traditional solutions and the usual methods used. As we can learn from the experience of integrating sustainability in higher education, it requires not only a re-evaluation of the internal institutional mission, but also a re-thinking of the teaching approach. "Teaching about sustainability presupposes that those who teach consider themselves learners as well and that students and other concerned groups of interest are considered as repositories of knowledge and feelings too." (Walls and Jickling 2002, p. 227). Expanding the network of mentors from the Faculty, to experts from other relevant institutions and to practitioners—should contribute to the enrichment of "repositories of knowledge and feelings" as well as of "real life perspectives" and opportunities to learn for all involved.

That process is, therefore, more than simply cooperation between the faculty and institutions, the local community or others. It is rather a network of interactive learning, facilitated rather than strongly directed by mentors, leaving space for freedom and responsibility for students as well as for other participants. In that sense, we understand collaborative learning as less directed, more student-centered, with stronger emphasis on the process than on the end result. Though cooperation is a necessary element of the process, in terms of teaching approaches, collaborative learning—in comparison with cooperative learning—is often seen rather as a philosophy, an approach to interaction between responsible learners, than as a classroom technique oriented towards accomplishment of a specific goal (Panitz 1997).

Another meaning of collaboration important for our approach is related to building closer connections between university and community. Embedded in different recommendations for developing sustainability at the university level, notions of practicing collaboration, community engagement and partnership are not being adequately applied, nor emphasized in the current literature (Renner and Cross in Leal Filho 2009). Opening space for local community representatives to collaborate with students as advisors creates potential for mutual contribution to sustainability, rather than for exercising the "social responsibility" of university, which might easily turn into a "one direction" process.

In that way, we may look at all the actors of this process as of a learning community, engaging students and teachers, as well as community members. In recent literature, especially in works of authors taking constructivist approach to instruction and learning, we may find different definitions, with at least few common elements characterizing community of learners: common working on projects and learning agendas, supporting and learning from one another as well as from their environment (Wilson 1996). Entire process of collaboration may be seen in

such a context as "co-construction of knowledge" not only between students and other actors, but within wider and long term partnership between university and community, which modalities largely differ nowadays, in accordance with the discourse and approach accepted by certain faculty or experts (Hall et al. 2015).

The concept of sustainable cities from its first definitions in the early 1990s, as the achievement of inhabitants' development needs without imposing unsustainable demands on local or global natural resources and systems, has developed to a much broader concept which integrates social development, economic development, environmental management and urban governance which refers to the engagement of different levels of authorities and institutions in management and investment decision-making processes. Its capacities to adapt—as an important aspect of the sustainability of cities is emphasized within the context of its particular history, policy priorities and the goals defined by each pillar (UN 2013).

In summary, we may underline the following principles established and incorporated in the process of the program development from the very beginning:

- Interdisciplinary orientation, in terms of content as well as the opportunity of students from other scientific fields to enter this master program
- Building connections between teaching and research projects undertaken within the Department for Urban Planning
- Establishing cooperation with relevant expert institutions and organizations in Serbia and abroad, including foreign universities
- Direct involvement of national and international experts in the teaching process
- Participation of students in international students' competitions in the field, in order to evaluate the quality and competitiveness of knowledge gained by participation in this study program.

The principles listed above served as guides in the development of the curriculum, formulated in order to establish its legitimacy and to increase awareness within professional circles about the necessity to educate new generations of urban planners using an integrated approach. In fact, the newly established study program has undertaken the mission of establishing a new professional paradigm in this field in Serbia.

3 Developing the Master's Thesis—A Process of Collaborative Learning

The great challenge for the newly established master's program was the formulation of the final master's work of the first generation of students. Creating the master's work took place during the final semester and was led by a mentor and two other members of the commission, the first from the parent field and other from the wider teaching faculty of the university. At the Faculty of Architecture the defence of the final master's thesis is open to the public and on that occassion an exibition of works was presented over several days. This was an opportunity for colleagues and

the wider professional public to gain an insight into the results of the students' work and assess their quality. Since the study program promotes new knowledge and establishes a new framework for professional work, the process of formulating the final project required careful consideration. A strategic decision was adopted that the formulation of the master's thesis would rely on the contemporary planning paradigm that with international involvement is introduced to urban planning with the cooperation of local government and its experts.

It was decided that the students' assignments rely directly on the "Strategy of integrated urban development of the central zone of Kragujevac", as one of the successful results of the international project "Improvement of land management at the local level in Serbia" funded by the Government of the Federal Republic of Germany and implemented by the German organization GIZ-AMBERO. Through cooperation with national and local institutions in Serbia, this organization promotes the new EU instruments for sustainable urban development aiming to improve and strengthen planning capacity in Serbia. "The strategy of integral urban development of the central zone of Kragujevac" was conducted in cooperation with the local government of Kragujevac by applying an innovative methodological approach with the participation of a wider range of stakeholders. Through the process of Strategy development, existing city policies, plans and adopted proposals directed towards sustainable industrial development were reviewed, encouraging investment in accordance with the interests of the public sector, investors and citizens' needs.

As a starting point for formulating the final master's works, individual integral intervention measures were chosen as specific results—outputs defined within the Strategy. The students' task was to choose a single concrete action and through research further develop it into a project solution. The reliance of the students' works on results obtained under the sponsorship of the European organization importantly grounded the content of the task within the framework of the new planning paradigm and in that way ensured the legitimacy of the topic. Thirteen integral measures within different areas of urban development of the city of Kragujevac were chosen and then shaped into specific project tasks and elaborated into concrete spatial solutions (Table 1).

In addition to direct mentors and members of the larger mentoring teams, the consulting team for the students' work included experts in urban planning from the most relevant institutions in Serbia such as a ministry (Ministry of Construction, Transport and Infrastructure), a scientific institute of national importance (The Institute of Architecture and Urban and Spatial Planning of Serbia), a national body for the issuance of professional licenses (Serbian Chamber of Engineers) and a city planning institution (Institute of Urban Planning of Belgrade). The members of the consulting team were also participants in the development of the Strategy of GIZ-AMBERO and Kragujevac (Fig. 1).

The process of the students' collaboration with consulting team members can be described as one of professional interactions that flowed in various forms:

Table 1 Strategic measures and topics of students' master's theses

Strategic measure	Master's thesis subject
Functional linking of the content within the complex "Milosev venac"	Promoting cultural heritage as a possible means for improving the quality of life in Kragujevac
Marketing of priority sites and potential construction land	Promotion of local economic development in the field of tourism as a function of good governance in Kragujevac
Reconstruction and improvement of the quality of public space, functionally linking urban and tourist focuses	Improving the quality of recreation within a public space through urban design
Relocation of a city market to a new space within the complex of quarters "Radomir Putnik"	The formation of a city marker in Kragujevac as a new place
Improving the territorial cohesion of focal areas—Kragujevac, an outdoor gallery	"Spread further"/Art District of Kragujevac
More intensive use of land and facilities and shaping the urban matrix	Revitalization of the coastal areas of the central city zone of Kragujevac aiming to integrate urban development
Improving pedestrian and bicycle traffic and the establishment of corridors	Green mobility as a function of the quality of life
"Art path" to the memorial park Sumarice	Collaborative artistic events as a driver to increase social interaction and community improvement
The more intensive use of land and facilities at the site of the army quarters "Milan Blagojevic" in Kragujevac	Model approach to the regeneration of brownfield for more intensive use of land and facilities—locality: army quarters "Milan Blagojevic"
Increasing capacity and improving the quality of services (public services in education, health and social protection)	Enhancing capacity in the field of higher education through public/private partnership
Organization of the events and exhibitions of the "Campus of Culture"	Regeneration of derelict land through temporary use
A program of support for small enterprises—establishment of BID/zones for the improvement of businesses	Implementation of the model for business improvement for regeneration of the Kragujevac central city zones
"Kragujevac—axis of education and innovation"—an update and improvement of educational content and the network in accordance with new technologies	Innovation district of Kragujevac

- *Professional dialogue*: new knowledge, adopted by downloading themes from the Strategy, and then discussed, elaborated and modified during work on the students' tasks.
- *Problem solving and research*: throughout the semester, the students and their mentors, along with period consultations with mentoring committee members, successively worked on the research and design of their solutions.

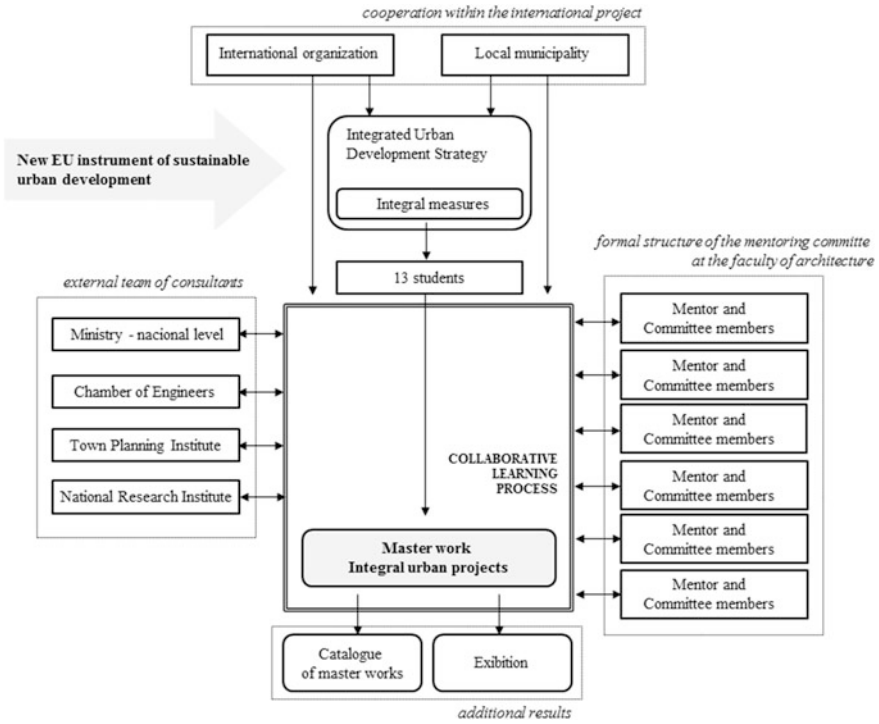

Fig. 1 Matrix of collaboration in the process of development of students' theses

- *Workshops and professional feedback*: during the semester two workshops with the consulting team were organized at which students presented the results achieved thus far and received useful suggestions for additional work.
- *Insight into the situation on the field*: students visited the town of Kragujevac and relevant locations and spoke with local government representatives.

As a result, during this process mentors presented the theoretical knowledge of new professional paradigms in the field, which were then analyzed and "passed through the filter" of the practical experience of prominent members of the consultant team and then elaborated and confirmed in the real context of the experts from the local government of Kragujevac. The process of creating the final master work, in that way, represented a "polygon" for collaborative learning, not only for the students themselves, but also for the experts within the field of theory and practice.

The final master works, after public defense and exibition at the Faculty, were presented and awarded second prize in the category of students work at the 23rd International urban planner's exibition in Belgrade. A bilingual catalog was also created and published as a material for the general promotion of these works, along with a manual for this innovative methodological approach to final master works (Maruna and Colic 2014).

4 Conclusion

The first master's study program at the Department of Urban Planning at the Faculty of Architecture, University of Belgrade developed on the principles of an integrated approach and based on the concept of sustainability not only initiated internal dialogue among faculty, but also discussion within a wider professional public regarding the professional development of a new generation of urban planners. The development of this program by using a bottom-up participatory approach provides a basis for further cooperation within and without the Faculty and a new opportunity for a wider range of stakeholders to take responsibility for the success of these goals.

In addition, involving a consulting team to work with students grounded student work in the framework of actual practices and the conditions in which the profession operates. The experience of working with the consulting team members had a significant role in establishing the final results of student work within a real context. This process-based concept of creating the final master work with the participation of the mentoring committee, members of the consulting team and participants in the development of the Strategy, essentially created space for a high-quality professional dialogue and, again, distributed responsibility for the learning process and its results.

The public success of the students' work was an indicator of both the quality of this process and of the motivation of the students involved, as well as that of their mentors and consultants. It represented a sort of public exam not only for the creators of the study program, but also for this new concept of master's studies. The experience proved that the collaborative learning process is a valid methodological approach for the development of high quality knowledge and that during its various stages it can be further improved. The Department for Urban Planning has now accepted the concept of collaborative learning as a successful approach for the development of a master thesis, and is continuing work on its improvement and further application in the next academic year.

Taking into account that, "planning besides sustainability should provide an adequate response to the increasingly visible effects of climate change, what is to some extent the task of sustainability planning, and also to provide conditions for adjustments" (Crncevic 2013:82), in the academic 2014/2015 year, the second generation of students in this master's study program "Integrated Urbanism" took the theme *Resilient Cities: Disaster Risk Management in Municipalities of Serbia* as a framework for developing the master's thesis, based on the methodological guidelines issued by UNSIDR—*How To Make Cities More Resilient: A Handbook For Local Government Leaders*.

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Campus Sustainability: Does Student Engagement with Eco-Campus Environmental Activities and Green Initiatives Really Matter?

Mohd Suki Norazah and Mohd Suki Norbayah

Abstract

This study seeks to investigate the relationship between (a) personal willingness towards environmental activities, (b) attitudes towards personal responsibility, and (c) attitudes toward the faculty's responsibility for creating a sustainable environment, and intention to engage in eco-campus environmental activities and green initiatives. The research used multiple regressions for data analysis in an attempt to achieve the objective across a sample of 374 students in a public university in Sabah, Malaysia. Their participation was purely voluntary. The construct validity was assessed by computing the exploratory factor analysis with varimax rotations. Empirical results revealed that personal willingness towards environmental activities, and attitudes towards the faculty's responsibility for creating a sustainable environment significantly affect students' intention to engage with eco-campus environmental activities and green initiatives. The first was found to have the strongest effect. The research provides a unique perspective of students' intention to engage with eco-campus environmental activities and green initiatives, which has previously not been much covered in the Malaysia context. The measurement produced can be used as a research tool for more exploratory and explanatory research regarding the investigated issues. Direction for future research is also presented.

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Keywords
Sustainability · Eco-campus · Attitudes · Environment · Green · Multiple regressions

1 Introduction

A sustainable university or green university is defined as "a higher educational institution, that as a whole or in part, addresses, involves in and promotes, on a regional or global level, the maximisation of positive environmental, economic, societal, and health effects of the use of resources to fulfil the functions of teaching, research, outreach, partnership, and stewardship in order to help society make the transition to sustainable lifestyles" Velazquez et al. (2006, p. 810). A green campus provides a sustainable environment for its society by focusing on aspects such as its finances, environmental conservation and partnership activities (such as recycling, waste reduction and community-outreach programs), transportation system, providing courses on sustainability as well as energy conservation programs.

Campus sustainability has received more attention from university management and policy-makers in Malaysia in recent years. More universities have increased their strategic commitment and established long-term goals for sustainability practices as part of university achievement. According to GreenMetric (2014), University of Putra Malaysia (UPM) is ranked 16th among 25 of the world's greenest universities, after University of Bath (ranked 15th) and University of California, Berkeley (ranked 14th). The ranking was based on several indicators such as overall campus setting (including number of students, percentage of areas in campus covered with planted vegetation, percentage of budget allocated for sustainability programs and efforts), energy and climate change efforts, waste management, water management, transportation system within the campus and sustainability courses offered by the university. The recent ranking shows that the higher education institutions in Malaysia are making progress with their serious efforts in achieving a sustainable campus.

In East Malaysia, Universiti Malaysia Sabah (UMS) is the only university that has currently set a target to become an eco-campus by 2018. With this goal, the university has seriously laid out 5 year plans to become a green university. Apparently, the Centre for EcoCampus Management was established in 2013 with five core values namely: sustainable development, ecological protection, resource conservation, environmental stewardship and environmental compatibility (EcoCampus Management Centre 2014). The centre continuously develops, implements and closely monitors the planned core activities in the eco-campus such as 3R (reduce, reuse, recycle) project, emission reduction project, energy and water audit and conservation, seminars and workshops, landscaping, as well as outreach programmes.

In an exploratory study on the readiness and development of green university in Malaysia, Hooi et al. (2012) found that one of the issues in green university initiatives was the poor awareness about the concept of sustainability among the campus society (this includes the faculty members, staff and students). Regardless of how a sustainable campus is defined or measured, it must always start with human behavioural change. Some research suggested that knowledge of sustainability is important to students as well as the campus society because a university is an ideal place to educate students on sustainability principals and practice which can be assessed by the learning environment as well as in pedagogical ways (Kagawa 2007; Norazah 2014).

There are minimal studies on students' intention to engage with eco-campus environmental activities and green initiatives in Asian countries, including Malaysia, as compared to Western countries (Lee 2008). Indeed, currently there is no specific, significant information on students' intention to engage with eco-campus environmental activities and green initiatives, particularly in the Malaysian context. Hence, this study seeks to investigate the relationship between (a) personal willingness towards environmental activities, (b) attitudes towards personal responsibility, and (c) attitudes towards the faculty's responsibility for creating a sustainable environment, and intention to engage with eco-campus environmental activities and green initiatives.

This chapter is organized as follows: the next section provides a review of literature, followed by the methodology applied. The succeeding section provides results of the findings and the discussion while the final section presents conclusions drawn from the results, and summarizes the implications of the study with directions for future research.

2 Literature Review

2.1 Personal Willingness Towards Environmental Activities

University should provide ample infrastructure to facilitate green activities and also to initiate more opportunities for students to get involve with green campus initiatives (Kagawa 2007). Besides the tangible facilities, motivation is vital as students are also consumers. Thus, they addressed consumers' responsibility in several actions such as changing their purchasing habits, recycling, saving the energy and/or water, and using the public transportation to commute. Even though changing behaviour takes time, when the students have experienced themselves with environmental activities in the campus (i.e. electricity usage reduction, saving the water, recycling) they are more motivated and started making the changes with their own willingness—where in the future can become natural habits (Savageau 2013). Hence, the following hypothesis is posited:

H1: Personal willingness towards environmental activities positively affects students' intention to engage with eco-campus environmental activities and green initiatives.

2.2 Attitudes Towards the Faculty's Responsibility and Attitudes Towards Personal Responsibility for Creating a Sustainable Environment

Attitude is a set of beliefs, an evaluation of a certain action (Ajzen 1991). This study looked into two types of attitude: internal attitude and external attitude. The internal attitude is the individual's personal belief in environmental sustainability efforts. Meanwhile, external attitude is the individual's evaluation of others in trying to achieve environmental sustainability. Numerous studies have indicated that attitude is one of the most substantial factors in adolescent consumers (Kim and Choi 2005; Lee 2008; Norazah 2014; Wahid et al. 2011). Personal responsibility attitude refers to individuals' beliefs in their ecological-related actions such as recycling or energy saving behaviour. The key to strong belief in ecological behaviour is the individual's "autonomous motivation" which then becomes a positive motivation to support environment-related activities while being more responsible in daily consumption (Huffman et al. 2014). According to Fraj and Martinez (2007), some people have a tendency to resist changing their habits as they believe that the faculty or their organization should be taking the responsibility for preserving the environment rather than them. Based on the literature, this study proposed that:

H2: Attitudes towards personal responsibility for creating a sustainable environment positively affect students' intention to engage in eco-campus environmental and green initiatives.

H3: Attitudes towards faculty's responsibility for creating a sustainable environment positively affect students' intention to engage in eco-campus environmental and green initiatives.

Based on the above mentioned literature, the proposed theoretical framework is illustrated in Fig. 1.

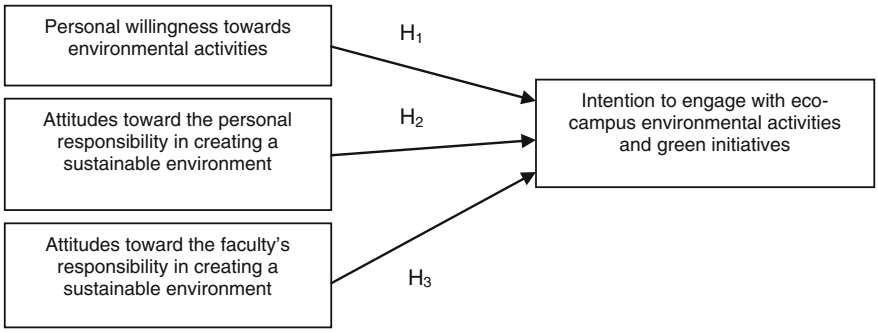

Fig. 1 Proposed theoretical framework

3 Methods and Research Instruments

3.1 Sampling

The respondents for this study were students at Kota Kinabalu Campus, Labuan International Campus, and Sandakan Campus of Universiti Malaysia Sabah (UMS) using self-administered questionnaires. Students were chosen because they belong to Generation Y (born between 1978 and 1994) and tend to be more concerned about the green environment and influence their parents' purchasing decisions (Coddington 1993; Tulgan and Martin 2001). The interviewees' responses were coded to allow the data to be stored, retrieved, and analysed by computer. The total sample size of this study was 374 according to the Krejcie and Morgan (1970) formula based on the total population of UMS students that is 14,329. For a better representation of samples from each faculty in UMS, proportionate stratified random sampling was applied to ensure respondents represented their groups. This was achieved by taking equal percentages of samples from each faculty.

3.2 Questionnaire Development

The first part of the three-section questionnaire contained general demographic questions, while the second part comprised questions about respondents' frequency of recycling. The final part of the questionnaire included sixteen questions on the students' personal willingness towards environmental activities, attitudes towards personal responsibility and attitudes towards the faculty's responsibility for creating a sustainable environment, and intention to engage in eco-campus environmental activities and green initiatives. The measurement items were adapted from the following sources: personal willingness towards environmental activities: 3 items (Figueredo and Tsarenko 2013), attitudes towards personal responsibility in creating a sustainable environment: 3 items (Emanuel and Adams 2011), attitudes towards the faculty's responsibility for creating a sustainable environment: 7 items (Emanuel and Adams 2011), and intention to engage in eco-campus environmental activities and green initiatives: 3 items (Fielding et al. 2008). All the items were measured on five-point Likert scales, with responses ranging from "strongly disagree" to "strongly agree". All were fixed-alternative questions, which required the respondents to select from a predetermined set of responses.

3.3 Statistical Techniques Used

Statistical techniques were used to process the data using descriptive, correlation, factor analysis, and multiple regression analysis via the computer program Statistical Package for Social Sciences (SPSS) version 21. The reliability of the data collected was determined using Cronbach's Alpha analysis. Finally, multiple regression analysis was performed to investigate the relationships between the independent variables (i.e. personal willingness towards environmental activities,

attitudes towards the faculty's responsibility and attitudes towards personal responsibility in creating a sustainable environment), and the dependent variable (i.e. intention to engage in eco-campus environmental activities and green initiatives).

4 Results

Table 1 enumerates the frequency analysis of respondents' socio-demographic background. 374 respondents were involved in this study of which 66 % were female and 34 % male. They were mainly Malays between 20 and 22 years old. More than three-fourths of the participants were undergraduates undertaking degree programs (95 %), 4 % were postgraduates.

4.1 Frequency to Engage with Environmental Activities

Descriptive statistics on respondents' frequency to engage with environmental activities such as recycle at home, use recycled paper, use recycle bins, recycle plastic bottles, and use public transport, including energy conservation in the past one month are detailed in Table 2. A significant number of respondents (86 %) have recycled at home at least six times in the past one month, while 20 % have recycled more than six times in the past one month. With regards to frequency of using recycled paper in the campus, only 10 % have done it more than ten times in the past one month, 50 % 1–3 times, and 20 % 4–9 times in the past one month. More than three-quarters of the respondents (78 %) use recycle bins, and 64 % re-use plastic bottles 1–6 times in the campus in the past one month. A quarter of the respondents have participated in energy conservation (i.e. reducing electricity usage) in the campus 4–6 times, close to half of the respondents provided a response of 1.3 times, whereas the balance have been participated more than ten times in the past one month. In the campus, 31 % of students have used public

Table 1 Socio-demographic profile of respondents

Variable	Frequency	Percentage	Variable	Frequency	Percentage
Gender			*Race*		
Male	128	34.2	Malay	169	45.2
Female	246	65.8	Chinese	51	13.6
Age (years old)			Indian	48	12.8
<19	122	32.6	Others	106	28.3
20–22	212	56.7	*Level of studies*		
23–25	28	7.5	Undergraduate	357	95.5
26–28	9	2.4	Postgraduate	17	4.5

Table 2 Frequency to engage with environmental activities

Items	1–3 times	4–6 times	7–9 times	10–12 times	>12 times
Frequency to perform recycling at home in the past one month	243 (65.0)	78 (20.9)	33 (8.8)	12 (3.2)	8 (2.1)
Frequency to use recycled papers in the campus in the past one month	185 (49.5)	108 (28.9)	45 (12.0)	19 (5.1)	17 (4.5)
Frequency to use the recycle bins to recycle in the campus in the past one month	179 (47.9)	112 (29.9)	43 (11.5)	14 (3.7)	26 (7.0)
Frequency to use the plastic bottles in the campus in the past one month	141 (37.7)	100 (26.7)	59 (15.8)	26 (7.0)	47 (12.6)
Frequency to involve in energy conservation (i.e. reducing the electricity usage) in the campus in the past one month	172 (46.0)	96 (25.7)	57 (15.2)	25 (6.7)	24 (6.4)
Frequency of using the public transport to campus in the past one month	151 (40.4)	56 (15.0)	26 (7.0)	24 (6.4)	117 (31.3)

Note Values in bracket refers to percentages

transport more than 12 times in the past one month, 28 % 4–12 times, 41 % less than three times in the past one month.

4.2 Factor Analysis of Willingness to Engage in Environmental Activities

Factor analysis of willingness to engage in environmental activities was run three items. This factor had eigenvalue of 2.147 and explained 71.555 % of the variance (see Table 3). The Kaiser-Meyer-Olkin was valued at 0.692 and the Bartlett's test score was significant ($\chi 2 = 362.811$, $p < 0.01$). The anti-image correlation analysis and communalities for all items exceeded 0.5. Factor loadings for all items were

Table 3 Factor analysis of willingness to engage in environmental activities

Items	Factor loadings
I am interested to take part in environmental volunteer work	0.881
I am willing to participate in recycling program held for eco-campus	0.844
I think I should be a green representative for the green campaigns in my campus	0.812
Eigenvalue	2.147
Percentage of variance explained	71.555
Kaiser-Meyer-Olkin measure of sampling adequacy	0.692
Bartlett's test of sphericity	362.811
Significant	0.000

Table 4 Factor analysis of attitudes toward personal responsibility for sustainability

Items	Factor loadings
I will support and participate in my faculty's initiatives to protect the environment	0.889
I want to help to create a sustainable campus, community and world	0.883
Eigenvalue	1.651
Percentage of variance explained	55.048
Kaiser-Meyer-Olkin measure of sampling adequacy	0.513
Bartlett's test of sphericity	183.410
Significant	0.000

well above the acceptable level of 0.50, ranging between 0.812 and 0.881. The first referred to the statement 'I think I should be a green representative for the green campaigns in my campus', while the last appeared for the statement 'I am interested in taking part in environmental volunteer work'.

4.3 Factor Analysis of Attitudes Toward Personal Responsibility for Sustainability

Attitudes toward personal responsibility for sustainability comprised three items. Principal component analysis was used as an extraction method in this factor analysis with varimax rotation. Eigenvalue of this analysis was 1.651 and 55.048 percent of the total variance was explained. The Kaiser-Meyer-Olkin was valued at 0.513 and the Bartlett's test score was significant ($\chi^2 = 183.410$, $p < 0.01$). In the anti-image correlation analysis, communalities for all items measured more than 0.5. Out of the three items, an item like 'I will not support my faculty's actions to protect the environment' was discarded for not meeting the cut-off value of 0.50. Table 4 exhibits the additional two items had loadings ranging between 0.883 and 0.889 where the first appeared in the statement 'I want to help to create a sustainable campus, community and world', and respondents were positive about item 'I will support and participate in my faculty's initiatives to protect the environment'.

4.4 Factor Analysis of Attitudes Towards the Faculty's Responsibility for Sustainability

Factor analysis was carried out for attitudes towards the faculty's responsibility for sustainability, which consisted of seven items (see Table 5). Factor loadings revealed scores in the range of 0.692–0.789 which were above the recommended threshold point of 0.50. Empirical results noted that the statement 'I believe that everyone in my faculty should support sustainable solutions to environmental problems' (loading = 0.789) turned out to have the highest factor loadings, followed

Table 5 Factor analysis of attitudes towards the faculty's responsibility for sustainability

Items	Factor loadings
I believe that everyone in my faculty should support sustainable solutions to environmental problems	0.789
I believe that my faculty should make sustainability in campus planning, development, and day-to-day operations	0.777
I want to help to create a sustainable campus, community and world	0.776
I do believe that everyone in my faculty should have to support sustainable solutions to environmental problems	0.776
I do believe it is necessary for my faculty to include environmental education across the curriculum	0.711
I will support my faculty's actions to protect the environment	0.710
I will support and participate in my faculty's initiatives to protect the environment	0.692
Eigenvalue	3.916
Percentage of variance explained	55.949
Kaiser-Meyer-Olkin measure of sampling adequacy	0.851
Bartlett's test of sphericity	1162.018
Significant	0.000

by 'I believe that my faculty should ensure sustainability in campus planning, development, and day-to-day operations' (loading = 0.777), and 'I want to help to create a sustainable campus, community and world' (loading = 0.776). Respondents considered 'I will support and participate in my faculty's initiatives to protect the environment' as the least vital item in determining their attitudes towards the faculty's responsibility for sustainability with loadings = 0.692. Eigenvalue of this analysis was 3.916 and the percentage of variance explained was 55.949 %. The Kaiser-Meyer-Olkin was valued at 0.850 and the Bartlett's test of sphericity result was significant at 0.000. The anti-image correlation analysis and communalities for all items were higher than 0.5.

4.5 Reliability Analysis

Table 6 shows that all constructs were satisfied to the criteria of reliability with Cronbach's Alpha values of more than 0.70 (i.e. Cronbach's Alpha ranging from 0.762 to 0.868), signifying satisfactory reliability for the scale items measuring each construct.

Table 6 Reliability analysis

Variables	No. of items	No. of item deleted	Cronbach's alpha
Willingness to Engage in Environmental Activities (WEE)	3	–	0.797
Attitudes toward Personal Responsibility for Sustainability (APR)	3	1	0.762
Attitudes towards the Faculty's Responsibility for Sustainability (AFR)	7	–	0.868
Behavioural Intention towards Environmental Activities (BIT)	3	–	0.825

4.6 Correlation Analysis

Pearson correlation coefficients were computed to describe the strength and the association between two matrix constructs. Table 7 shows that all inter-construct correlations were below 1.00, significant and positively correlated at the $p < 0.05$ level, displaying a positive correlation array among matrix variables. Significance results show no multicollinearity problem exists in this research. With regards to association with students' intention to engage in eco-campus environmental activities and green initiatives, personal willingness towards environmental activities (r = 0.287, $p < 0.01$) turned out to have the strongest correlation coefficients.

Next, attitudes towards the faculty's responsibility in creating a sustainable environment (r = 0.240, $p < 0.01$) significantly correlated with students' intention to engage in eco-campus environmental activities and green initiatives. Last but not least, the study showed that attitudes towards personal responsibility in creating a sustainable environment had a significant and positive link with students' intention to engage in eco-campus environmental activities and green initiatives. Respondents mainly agree with and rated 4 = agree on two dominant factors namely, attitudes toward personal responsibility for sustainability (M = 4.051), and attitudes toward faculty's responsibility in creating a sustainable environment (M = 4.035).

Table 7 Inter-construct correlations

Variables	WEE	APR	AFR	BIT	Mean	SD	Skewness	Kurtosis
WEE	1.000				3.823	0.743	−0.127	−0.356
APR	0.489**	1.000			4.051	0.690	−0.356	−0.052
AFR	0.446**	0.528**	1.000		4.035	0.628	−0.542	0.260
BIT	0.287**	0.193**	0.240**	1.000	3.454	0.699	0.244	0.423

Notes **Correlation is significant at the 0.01 level (2-tailed); SD = Standard deviation

4.7 Relationships with Students' Intention to Engage in Eco-Campus Environmental Activities and Green Initiatives

In the regression model, the independent variables (i.e. personal willingness towards environmental activities, attitudes towards the faculty's responsibility and attitudes towards personal responsibility in creating a sustainable environment), and the dependent variable (i.e. intention to engage in eco-campus environmental activities and green initiatives) were entered. The explanatory power (R^2) of the predictor construct (i.e. intention to engage in eco-campus environmental activities and green initiatives) is 29 %, indicating that the model accounts for 29 % of the variance in the dependent variable. All independent variables have variance inflation factor (VIF) values ranging from 1.404 to 1.560 which is less than the cut-off point of 10, and tolerance values ranging from 0.641 to 0.712 which is above the threshold of 0.10, thus ensuring that multicollinearity is absent. The Durbin-Watson value was 1.924 (see Table 8), which was relatively near to 2, showing the independence of error term.

Figure 2 exhibits the normal probability plot (P–P) and the scatter plot of the model where no major deviations from norms exist, with most of the scores rectangularly distributed in the centre.

Table 8 details the unstandardized β-coefficient among the independent variables ranging from 0.015 to 0.207. The multiple regression equation is specified below:

Intention to engage in eco-campus environmental activities and green initiatives = 2.000 + 0.207 (personal willingness towards environmental activities) + 0.015 (attitudes towards personal responsibility in creating a sustainable environment) + 0.149 (attitudes towards the faculty's responsibility for creating a sustainable environment).

H1 postulated that personal willingness towards environmental activities positively affects students' intention to engage with eco-campus environmental activities and green initiatives. The study result, as available in Table 8, supports this assertion; the standardized beta coefficient is 0.220, *t*-value > 1.960, and $p < 0.05$.

Table 8 Relationships with students' intention to engage with eco-campus environmental activities and green initiatives

	Unstandardized coefficients		Standardized coefficients			Collinearity statistics	
	B	Std. Error	Beta	*t*	Sig.	Tolerance	VIF
(Constant)	2.000	0.252		7.922	0.000	–	–
WEE	0.207	0.055	0.220*	3.767	0.000	0.712	1.404
APR	0.015	0.062	0.014	0.235	0.814	0.641	1.560
AFR	0.149	0.067	0.134*	2.236	0.026	0.675	1.481

Notes *Statistically significant at $p < 0.05$ (for *t*-value > 1.960); Durbin-Watson = 1.924

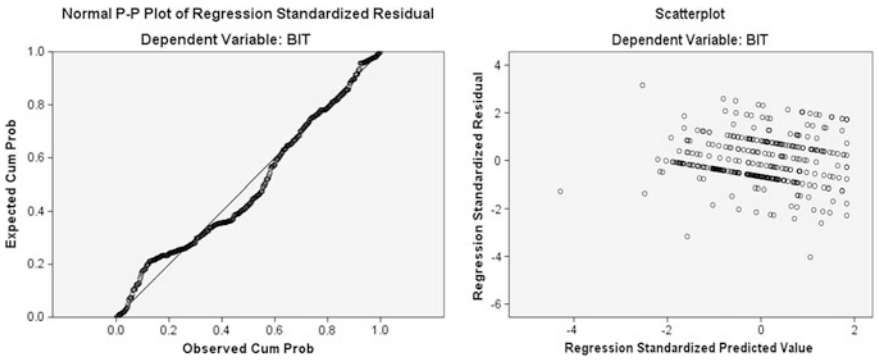

Fig. 2 Normal probability plot (P–P) and scatter plot

In H2, it is proposed that attitudes towards personal responsibility in creating a sustainable environment positively affect students' intention to engage in eco-campus environmental activities and green initiatives. However, the t-value < 1.960, infers the result does not support this hypothesis ($\beta_2 = 0.014$, t-value = 0.235, $p > 0.05$). Thus, H2 is not reinforced. The final hypothesis, H3 states that attitudes towards the faculty's responsibility for creating a sustainable environment positively affects students' intention to engage in eco-campus environmental activities and green initiatives. The result shows the standardized beta coefficient of 0.134 with t-value > 1.960 and $p < 0.05$, hence supporting H3.

5 Discussion

This study investigated the relationship between personal willingness towards environmental activities, attitudes towards personal responsibility and attitudes towards the faculties' responsibility for creating a sustainable environment, and intention to engage in eco-campus environmental activities and green initiatives. Empirical results of multiple regression analysis revealed that personal willingness towards environmental activities affects students' intention to engage in eco-campus environmental activities and green initiatives. Hence, H1 is supported. This factor was found to have the strongest effect. This result is comparable with prior findings (Savageau 2013). Students stated that they should be green representatives for the green campaigns in the campus. They are also interested in taking part in environmental volunteer work, and eco-campus environmental activities and green initiatives. Indeed, they are also willing to participate in recycling programs held for the eco-campus.

Next, the link between attitudes towards the personal responsibility for creating a sustainable environment and students' intention to engage with eco-campus environmental activities and green initiatives is executed in H2. Surprisingly, this hypothesis is not supported. Based on the exploratory factor analysis, students'

attitudes towards personal responsibility in creating a sustainable environment is positive when they state that they are willing to help the university management to create a sustainable campus, express positive support and participate in faculty's initiatives to protect the environment.

The final factor, attitudes toward the faculty's responsibility for creating a sustainable environment, is rated highly among students in impacting their intention to engage with eco-campus environmental activities and green initiatives. The strength of the connection between the two constructs provides evidence that attitudes towards the faculty's responsibility for creating a sustainable environment has a positive and significant influence on students' intention to engage with eco-campus environmental activities and green initiatives, signifying H3 is sustained. Students' rated agree on item 'I believe that everyone in my faculty should support sustainable solutions to environmental problems', followed by 'I believe that my faculty should ensure sustainability in campus planning, development, and day-to-day operations'. This significant finding coincides with prior studies such as Huffman et al. (2014), Lee (2008), Norazah (2014), Wahid et al. (2011).

6 Conclusion

The research provides a unique perspective of students' intention to engage in eco-campus environmental activities and green initiatives, which is not much covered in the literature in the Malaysia context. In terms of theoretical implications, the measurement produced can be used as a research tool for more exploratory and explanatory research regarding the impact of personal willingness towards environmental activities, attitudes toward personal responsibility and attitudes toward the faculty's responsibility in creating a sustainable environment, on students' intention to engage with eco-campus environmental activities and green initiatives.

In addition, results of the research study suggest that attitudes toward the faculty's responsibility in creating a sustainable environment are important discussion areas that may need further attention, beside aspects of personal willingness towards environmental activities. Hence, from managerial perspectives, university management should arouse students' intention to engage in eco-campus environmental activities and green initiatives so that everyone in the faculty should support sustainable solutions to environmental problems. It is crucial for university management to emphasize sustainability in campus planning, development, and day-to-day operations. Interestingly, the study confirms that students support and participate in the faculties' initiatives to protect the environment. It is also necessary for faculty to include environmental education across the curriculum. For instance, green marketing should be introduced in the faculty that offers business and management disciplines.

The sample in this study was only distributed among 374 students in a public university in Sabah, Malaysia, limiting the generalizability of the research findings. Therefore, enlargement of the sample is suggested in future research as different nationalities would present differing attributes of personal willingness towards environmental activities, attitudes towards personal responsibility and attitudes towards the faculties' responsibility for creating a sustainable environment, and intention to engage with eco-campus environmental activities and green initiatives. The results could be used for comparative purposes and to overcome the limits of generalizability in sample coverage.

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Supporting Grassroots-Led Initiatives in the Spanish Energy Field Through Transformative Education for Sustainable Development

Victoria Pellicer Sifres, Pau Lillo Rodrigo and Alejandra Boni Aristizábal

Abstract

This chapter aims to contribute to the reflection on the optimal way to encourage **stakeholder engagement for Education for Sustainable Development (ESD) in Higher Institutions (HI).** Firstly, we reflect on the role that higher education should play in the global transformation towards sustainable futures. Our goal is to contribute to a more critical framework for conceptualizing ESD—the "Transformative ESD"—which promotes deeper transformative processes to achieve sustainability within HI in comparison to more conservative approaches, and requires the inclusion and coordination of different stakeholders. Secondly, we propose several characteristics to develop a Transformative ESD processes at universities, integrating research, teaching and stakeholder's engagement. Thirdly, we present and analyse an experience at the Universitat Politècnica de València on the sustainable energy field, which was developed by the authors as researchers and teachers, through the engagement of three social organizations, during 2014 and 2015. This experience includes a broad range of activities: research, teaching, awareness raising and policy advocacy. The activities promote Transformative ESD in different terms: supporting sustainable grassroots-led

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initiatives; questioning the current energy system (ES) and analysing its dramatic consequences (i.e. high levels of fuel poverty); proposing a new one more sustainable and fairer; and promoting energy savings and efficiency, renewable energies, energy sovereignty and democratisation. The main findings of our research show us that encourage stakeholder engagement in a Transformative ESD process at universities implies considering a multi-stakeholder and an interdisciplinary team. Moreover, the process should be implemented from a participatory approach, based on the establishment of meaningful relationships between HI and citizenry, and should promote social transformation towards sustainable futures.

Keywords

Higher education · Sustainability · Critical framework · Energy · Grassroots-led initiatives · Participatory approach

1 Different Approaches to Sustainability in Higher Education

Various debates exist on the role public university plays in our society and the role it should be playing. Several theories characterise the aims, functions, mission and practices of universities, in terms of teaching, researching and community engagement.

Currently, as Bessant et al. (2015) remark, the most widespread ideology is that of neoliberalism, which is based upon the principles of economic liberalisation and decentralisation (free trade, open markets, privatisation, deregulation and decrease in the welfare role played by state). It also has significant implications for the vision and mission of education in general, and Higher Education (HE) in particular.

In this sense, with reference to universities, neoliberalism has contributed to a highly competitive higher education set-up, as universities are becoming evermore fiscally focused, businesslike and managerialist, and we are witnessing some huge transformations concerning the purpose, mission and framing of higher education (Bessant et al. 2015). The changing direction of university strategic plans and policy priorities towards increased income generation, innovation, commercial enterprise, business engagement and, indeed, the advent of university 'corporate' plans highlight this change (Jary 2005; Marginson 2007; NEF 2008; Streeting and Wise 2009; McArthur 2011 as cited in Bessant et al. 2015).

However, HE has been extensively studied and criticised for undermining its core values by choosing to uphold the neoliberal ethos and for the consequent inevitable trade-offs with other values such as social justice, equity, environmental protection and ethical and democratic decision-making (Devaney and Weber 2003).

In the 30th anniversary edition of his seminal work, 'Pedagogy of the Oppressed' (Freire 1970), Richard Shaull closes the foreword of the book with the following words:

> There is no such thing as a neutral education process. Education either functions as an instrument which is used to facilitate the integration of generations into the logic of the present system and bring about conformity to it, or it becomes the 'practice of freedom', the means by which men and women deal critically with reality and discover how to participate in the transformation of their world (Shaull 2006).

(McArthur 2011) explores these critical issues in depth. She states that *'such a change suggests that higher education is primarily seen as a tool that contributes to the achievement of other primary goals – namely business, innovation and skills – rather than a priority in its own right'.*

The Sustainable Development (SD) approach entails this transformative concept towards education in general and HE in particular. As (Leal Filho 2015) explains, SD should pursue the attainment of values of care, peace, truth, justice, tolerance and kindness (CEE 2007 cited in Leal Filho 2015). From this perspective, different reflections are presented about what role higher education should play in the global transformation towards sustainable futures (Beringer and Adomßent 2008), and which groups of stakeholders should be involved. In accordance with this, the present chapter supports the following idea related to Sustainability in Higher Institutions:

> HE's fundamental responsibility towards sustainability is espoused on many grounds, including its critical role as a societal leader, future shaper and exemplar of best practice, its influence on local and national policy, and its role in educating the next generation of global citizens (van Weenen 2000; Corcoran and Wals 2004; Gough and Scott 2008 as cited in Bessant et al. 2015).

In the following section we will expand this idea of SD in higher studies, focusing on the realm of Education from a critical framework.

2 Transformative Education for Sustainable Development in Higher Education

The concepts of SD and of education as being imperative in the drive towards sustainability, were largely born out of two key events: the United Nations World Commission on Environment and Development in 1987 and the United Nations Conference on Environment and Development in Rio de Janeiro 1992 (Leal Filho 2000). Both reports concluded that ecological and social failures showed common causes and thus required common responses (Kemp et al. 2005).

Since then, a multitude of literature has been written about the concept of SD. Recent evidence suggests that the implementation of SD projects has to be focused not only on the economic and environmental dimensions, but also on a social dimension (Froger et al. 2004). This is driven by an increasing awareness that sustainability problems cannot be solved solely by scientific knowledge (Selman

and Parker 1997), and consequently local and expert values have to be considered, through the engagement of an interdisciplinary group of stakeholders.

With reference to this, the concept of Education for Sustainable Development (ESD)—a central issue in the realm of SD—is commonly defined as follows:

> ESD is a vision of education that seeks to balance human and economic well-being with cultural traditions and respect for the earth's natural resources. ESD applies transdisciplinary educational methods and approaches to develop an ethic for lifelong learning, fosters respect for human needs that are compatible with sustainable use of natural resources and the needs of the planet and nurtures a sense of global solidarity (UNESCO 2002).

Focusing on ESD in Higher Institutions (HI), the international mandate to make universities and colleges lead partners in global sustainability efforts has resulted in a flurry of activities and initiatives both in public policy as well as in practice. As Beringer and Adomßent (2008) indicate, different types of sustainability in HE projects may be discerned on a spectrum, where the 'traditional' (…) *greening the campus initiatives* are: the projects, campaigns, initiatives (paper-cut campaign, curriculum reform to include more sustainability content) that seek to change one or a limited number of operational or academic aspects. At the other end we find sustainable university research and development projects (…) which seek institutional transformation for a dual purpose: institutional improvement in terms of sustainability, and the progress of science and generation of knowledge.

We will follow the second approach, and make the case for a "Transformative ESD". As Bessant et al. (2015) remark, Transformative ESD requires more radical and fundamental change, which goes beyond 'integrating', 'embedding' or 'mainstreaming' sustainability within HE. Consequently, calls have been made for a more transformative system that places sustainability at the heart of HE's 'raison d'être' (Sterling et al. 2013): *"an epistemic and paradigmatic reorientation of universities towards sustainability which fundamentally changes the make-up and ideology of the system itself"*.

Transformative ESD recognises the importance of engaging different groups of stakeholders committed with ESD, since it has significant benefits. As Barnes and Phillips (2000) indicate, *"partnerships can enable a whole variety of practical outcomes, by-passing the sterility of many traditional approaches to academic work. (…). Contributions from academics and practitioners (…) can help to ensure they combine academic rigor with grounded applied objectives"*. From this partnership approach, local knowledge proceeding from social organizations and civil society is also considered and valued, and it complements scientific-rational knowledge, generally created at HI.

Accordingly to this, in this chapter we reinforce the idea that Transformative ESD in HI is not only a matter for researchers, teachers or students, but also for civil society, social organizations, and other actors such as private sector or other public sectors (administration departments, etc.).

3 A Comprehensive Approach to Transformative ESD

The previous literature reviewed has highlighted the urgency of educating university students from a Transformative ESD approach, in which research, teaching and community engagement are driven so as to encourage students to be critically engaged with sustainability issues as well as equipping them with the skills to contribute towards a more sustainable future. What's the role of research and teaching for it? How different stakeholders could be engaged? How it could be linked with a Transformative ESD approach in higher education?

For one side, with reference to research in ESD, Bessant et al. (2015) point, that it is essential in order to understand the successes and challenges of the role of educating for a sustainable future, and to drive sustainability activity in institutions.

An interesting approach to ESD research is proposed by Robottom and Hart (1993):

> […] one which includes consideration of both human consciousness and political action and thus can answer moral and social questions about educational programs which the dominant form [research paradigms] cannot. It is one which is more consistent with the ecophilosophical view – which encourages individuals to be autonomous, independent critical and creative thinkers, taking responsibility for their own actions and participating in the social and political reconstruction required to deal intelligently with social/environmental issues within mutually interdependent and evolving social situations (Robottom and Hart 1993 quoted in Fien 2002).

This approach is linked with the idea of Transformative ESD, since it is based on core values such as justice, critical thinking, environmental ethic and democratic participation. According with this, Beringer and Adomßent (2008) explain that "*sustainable university research speaks to the issue of ethics (responsibility and accountability) and aims to generate not only cognitions and technical expertise, but also ethical knowledge*" (Donner and Weiß 2000 as cited in Beringer and Adomßent 2008). From our perspective, these ideas also apply to teaching and community engagement, thus creating a comprehensive framework within Transformative ESD.

Considering initiatives to promote stakeholders engagement, there are several different techniques and strategies that are generally used. Nevertheless, there are some transversal elements to be considered in these processes, such as the establishment of meaningful relationships or fostering existing ones, willingness to learn about the aims and activities of local organizations, consideration of potential mutual interests and benefits areas, and careful consideration of the needs of the organization (Barnes and Phillips 2000).

Within this spectrum, this chapter presents a proposal with some elements for implementing Transformative ESD, integrating research, teaching and stakeholder's engagement. These proposed elements are structured into three parts: the first one defines the actors engaged with a Transformative ESD initiative; the second one suggests characteristics and strategies for implementing it; and the third one indicates the goals and objectives sought (Fig. 1).

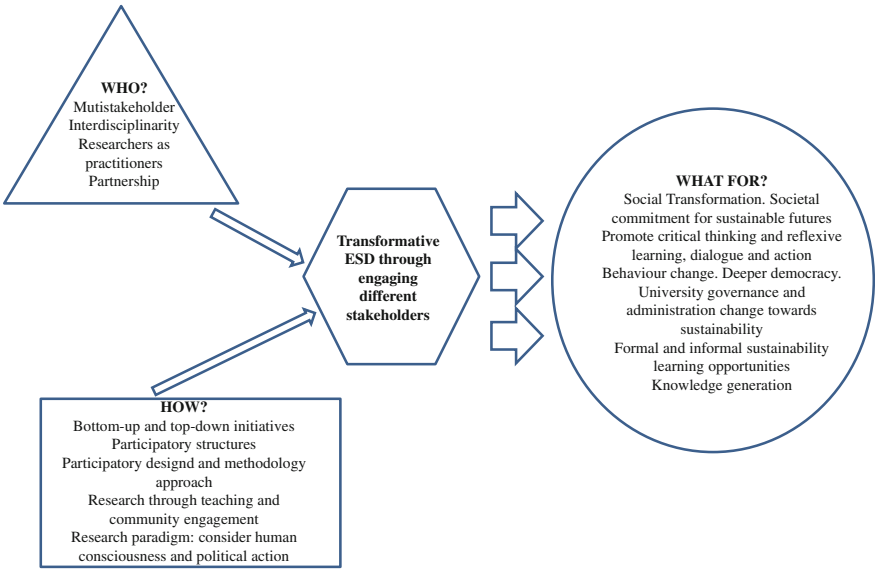

Fig. 1 Elements for implementing transformative ESD

Regarding the first part—"**WHO participate in the Transformative ESD initiative**?"—various authors highlight these elements:

- **Multi-stakeholder approach**: Sustainable university projects rely on multi-stakeholder processes and engagement, both within the internal campus community as well as with external parties (Beringer and Adomßent 2008; Barnes and Phillips 2000; Moore 2006).
- **Interdisciplinary approach**: Knowledge of other disciplines, their world-views and methodologies. Mutual respect for roles of disciplinarians and generalists. Ability to work together in teams and use interdisciplinary frameworks to integrate knowledge (Sherren 2008; Moore 2006).
- **Duality in role and responsibilities**: The researchers and the researched are one and the same. Its researchers are also its practitioners; the researcher-practitioner cannot separate her-/himself from the effects or implications of her/his research, as in many other forms of science (Beringer and Adomßent 2008).
- **Partnership approach**: Benefits arise through partnership work between higher education institutions and other local organisations in the environmental sector (Barnes and Phillips 2000).

Concerning the second part—**HOW is Transformative ESD implemented?**—the main issues identified are:

- Combine **'bottom-up'** campaigns with **'top-down'** policy initiatives, to exploit the synergies for sustainability that exist when the two subsystems of

management/operations and academe are respected as holons within a larger system (Beringer and Adomßent 2008).
- Design **participatory structures**, for instance via multi-stakeholder processes or two-way dialogues, to enable democratic communication between researchers and the researched—toward high levels of acceptance, buy-in and engagement, for on- and off-campus community members (Tormey et al. 2008; Froger et al. 2004).
- Implement **participatory design/methodology/approach**, for instance Action Participatory Research (based on a cyclical process of action, observation, reflection and adaptation) (Tormey et al. 2008).
- Integrate **research, teaching and services,** due to the necessity of implementing more suitable approaches, instead of the traditional single disciplinary approaches where research, teaching and services on innovation for sustainability need to be systematically linked (Moore 2006; Posh 2014).
- Adopt a **research paradigm** which includes consideration of both human consciousness and political action (Fien 2002; Sherren 2008).

Finally, the third part—**WHAT is the purpose of a Transformative ESD?**—the main goals envisioned are:

- That it is conceived in service of **social transformation**. To seek to realise its **societal commitment for sustainable futures**, by seeking to influence state/provincial, national and international public and educational policy as well as the higher education system/s toward preferred, more sustainable alternatives (Beringer and Adomßent 2008; Bessant et al. 2015; Devaney and Weber 2003).
- Create spaces for pedagogical transformations, promoting **critical thinking** and **reflexing learning**; **dialogue** and **action** (Moore 2006).
- Complement technical and behavioural sustainability interventions, and use **behaviour change methods** (Caners 2006 as cited in Bessant et al. 2015), since *"environmentally sensitive behaviour starts with individuals having an understanding of the consequences of their behaviours (knowledge)"* (Too and Bajracharya 2015).
- Work towards cementing sustainability principles in **university governance and administration;** and on HE policy level (Bessant et al. 2015; Sherren 2008; Froger et al. 2004).
- Offer **formal and informal sustainability learning opportunities** on campus and reflect on its curriculum and teaching (Barth 2013).
- To be **committed to knowledge generation**, to contribute to a clearly definition of sustainability (Owens and Legere 2015), knowledge transfer and capacity-building for sustainability, as evidenced in publications, conference presentations, and community-based dissemination strategies (Beringer and Adomßent 2008; Posh 2014). If an institution desires to instill the next generations with a firm understanding of sustainability, then they must define it for themselves and express this definition clearly to their populations. Sustainability has far too many proponents with a range of at times opposing goals to allow its definition to be left to creation by mélange. What it is up to the administrators and educators at IHEs to determine whether an expansive yet muddy

understanding of sustainability is sufficient for their own goals of creating an educated citizenry.

4 Supporting Grassroots-Led Initiatives in the Energy Field Through Transformative ESD

The Spanish Energy System (ES) is widely considered to be unfair and unsustainable for various reasons, such as centralised power and benefits, lack of competitiveness (oligopoly), huge economic deficit, weak accountability and answerability, revolving doors, etc., which have produced a significant impact on Climate Change and high Fuel Poverty rates (Lillo and Pellicer 2014).

In this context, Universitat Politècnica de València (UPV) has promoted and supported grassroots-led initiatives in terms of ESD, aimed at achieving a new, fairer and more sustainable ES, including energy savings and efficiency, renewable energies, energy sovereignty and democratisation.

On the basis of the diverse strategies defined in Sect. 4, several activities have been carried out to achieve these goals, which are described subsequently.

Considering academic **research**, there is one project funded by the Government, aimed at analysing grassroots initiatives against Climate Change, and 2 Ph.D. theses which are principally characterised by being linked to the problems caused by the current ES in Spain. This research, together with further activities described below, is being developed together with grassroots organisations that are working to transform the ES, such as the Platform for a New Energy Model (a partnership of environmentally-committed collectives), Som Energia (a non-profit green energy cooperative) and Engineering Without Borders (a development NGO). As an example of the outcomes of these activities, two research articles have been published, reflecting upon the influence of the Spanish ES on Fuel Poverty and the role of the citizenry in changing it (Lillo and Pellicer 2014) and contributing to and promoting the debate surrounding the conceptualisation of Fuel Poverty in a wider theoretical framework, focusing on people's freedoms: the Human Development approach (Pellicer and Lillo 2014).

Regarding **knowledge diffusion and teaching**, several activities have been performed lately. Firstly, Sustainable Development seminars have been established in the Master in Cooperation for Development at UPV, to analyse and discuss different views on Fuel Poverty, its causes and effects, and which strategies might be used to diminish and ultimately prevent this problem in Spanish society. Secondly, within the course named "Green skills for boosting transitions", organised by Climate-KIC[1] at the UPV, the authors presented the successful case of Som Energia, a non-profit green energy cooperative that aims to promote change in the Spanish ES towards a 100 % renewable energy system. Thirdly, within a Climate-KIC Alumni assembly in Valencia, the authors prepared a workshop on the

[1]An important European public-private innovation partnership.

Spanish ES, its main characteristics, advantages and disadvantages on the basis of the Sustainable Development approach, and what the strategies to address the problems should involve. Finally, as part of the Solar Photovoltaic Energy diploma at the university, three special workshops were organised by the Platform for a New Energy Model, together with the authors, to discuss Fuel Poverty, Fracking and the Spanish Energy Market. In the first, we discussed the concept of Fuel Poverty and the consequences this problem has on people's lives. We analysed the factors that are provoking increasing rates of Fuel Poverty and discussed possible solutions to the current situation. In the second, we described the impact this practice might have on the environment, what the current pattern of energy mix in the world is, and what alternatives would be feasible to achieve a shift to a 100 % renewable energy system. In the third, we presented how energy prices are established in Spain, described and analysed the energy laws and regulations, and analysed their consequences on renewable energy development.

Regarding **policy advocacy initiatives**, the UPV hosted and funded the Energy and Environment Forum 2015, organised by the authors and the Platform for a New Energy Model, where political representatives of the 7 main political parties debated their energy and environment proposals for the new legislature in Valencia (Spain). This event included a space where the citizenry could present doubts and proposals, and discuss them directly with the politicians. In this way, the UPV contributed to creating a new political model, one in which the wills and opinions of the citizenry can be directly addressed to decision makers, thus strengthening the democratic processes (Fig. 2).

Fig. 2 Initiative of transformative ESD in UPV

5 Discussion

The case study analysed exhibits most of the elements presented in the first four Sections, hence it allows us to proceed with the discussion on how Transformative ESD should be carried out at universities.

Next, we analyse the most significant key points of the case study, focusing especially on WHO participates in the initiative, HOW it is implemented and WHAT it is for.

5.1 Who Participates in the Transformative ESD Initiative?

This initiative has been developed in coordination with **diverse stakeholders**, thus strengthening partnerships. One of the key elements that catalyses the interaction between different stakeholders (university and the citizenry) is the fact that university members are part of the organisations involved and actively participate in their assemblies. From this position, authors as researchers question their responsibility in the current ES and—understanding that they are also practitioners—they are committed to bringing this organisation into closer contact with the university.

Moreover, this Transformative ESD initiative can be considered as **transdisciplinary**, as it explores the link between Energy and Society. Not only has it delved into technical issues, such as fracking or renewable energies, but also into the social impacts of the ES. Transdisciplinarity has promoted the participation of multiple stakeholders, i.e. technicians, seniors, activists, sociologists, etc. Hence it has enabled the scope to be broadened, raising consciousness of diverse sectors of the civil and university population about the urgency of changing the current Spanish energy system.

Nevertheless, this example shows the internal departments, i.e. environment, infrastructure or cooperation for development areas, have difficulties in engaging and working together on this kind of activities with stakeholders who do not belong to the university. In fact, in this case the relationship between them has been instigated by the researchers, but close and lasting links between them have not been achieved yet. Different organisation schemes, goals and approaches have proven to be significant barriers to working together, but overloaded agendas and schedules have also hindered a robust collaborative process.

5.2 How Is Transformative ESD Implemented?

This methodology has a **bottom-up approach**, as it is aimed at answering social claims not defined by the UPV itself, but by grassroots initiatives. Moreover, the methodology used in all activities is based on **participatory principles**, as the design, implementation and discussion of results are shared with all the

stakeholders involved. Nevertheless, it cannot be considered as Participatory Action Research because the core research is carried out by members of UPV.

This case study shows the **link between research and teaching**, in addition to presenting a clear example of university **commitment engagement** in ESD. However, evidence shows that this approach is only used in specific, isolated activities, which are not structured nor completely included within the university educational plans. Hence, ESD teaching might potentially be used only in spaces where people involved are already aware of the need to deal with sustainability approaches, i.e. a Masters Degree in Cooperation for Development, thus limiting its transformative potential.

5.3 What Is the Purpose of a Transformative ESD?

Transformative ESD activities, based on the **critical paradigm**, aim to promote social consciousness, as well as to **contribute to policy advocacy**. In this sense, the use of the Human Development approach, which was never used in this kind of analyses in the past, has been a key element to enable these goals to be reached. Hence, the research projects have also contributed to the generation of knowledge, adding a **new successful theoretical-conceptual framework** to the current discussion on sustainability for development in Spain. The diverse actions carried out have also promoted **critical consciousness** with relationship to the influence of the energy system on society, presenting feasible alternatives to reach **social**

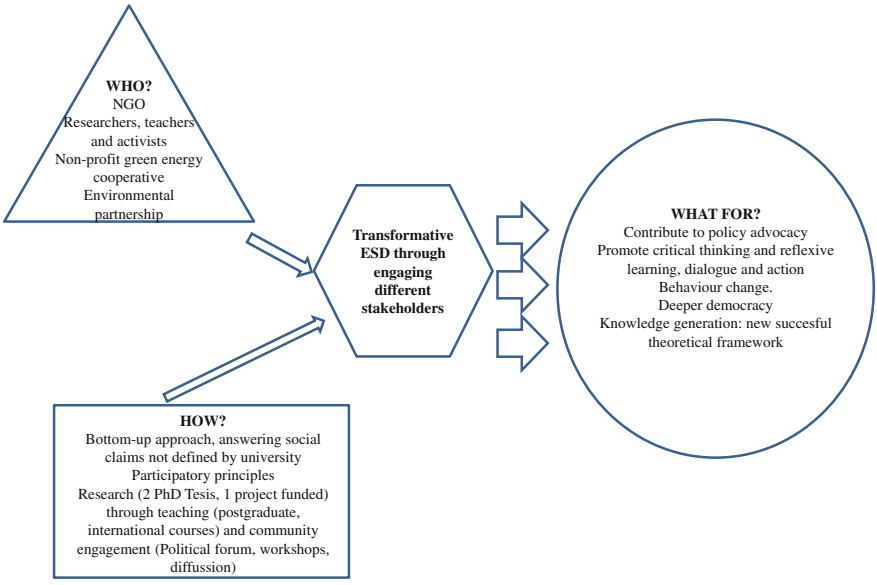

Fig. 3 Elements of transformative ESD initiative in UPV

transformation, such as energy consumption options, strategies to prevent Fuel Poverty or participatory spaces for **deeper democracy**. As presented in Sect. 4, this should be one of the goals and responsibilities of public universities.

However, regarding university governance, UPV is not building a transformative strategy towards sustainability. Bottom-up strategies, such as the one presented above, should be combined with top-down ones, thus engaging decision makers to establish new policies, regulations, internal structures, etc., in order to have a greater and more sustainable impact (Fig. 3).

6 Conclusions, Limitations and Recommendations

From our perspective, HE should contribute to the achievement of broader and deeper goals than those related with neoliberal paradigm (business, innovation, skills…) by focusing on promoting core values such as justice, equity, environmental protection, democracy, participation and critical view. In this sense, HE has a clear responsibility towards the promotion of sustainable futures, considering the participation of different stakeholders.

To look into this view of HE, this chapter has proposed several characteristics to develop transformative ESD processes at universities.

Firstly, concerning the actors WHO participate, we propose to consider a multi-stakeholder team, not only considering various parties in the internal campus community but also the external ones, such as local organisations or civil society. Moreover, it is interesting to establish an interdisciplinary team, so as to create knowledge from different disciplines and parties. Within this multi-stakeholder and interdisciplinary team, it may result the case that researchers and researched are the same (researchers-practitioners). Secondly, regarding the process about HOW Transformative ESD should be implemented, the main issues proposed are to combine bottom-up campaigns with top-down initiatives; to create participatory structures so as to co-design the research and to integrate teaching tasks and community engagement. Lastly, relating with WHAT is the purpose of a Transformative ESD, the main goals envisioned have to do with social transformation towards sustainable futures: promote critical thinking and reflexive learning; facilitate behaviour change; cementing sustainable principles in university governance and administration; offer formal and informal sustainability learning opportunities; and be committed to knowledge generation.

These elements have been analysed in a case study at UPV, which considers research activities, teaching, diffusion, increasing sensitivity and policy advocacy regarding promotion of sustainable energy systems in Spain.

Our analysis confirms the relevance of including groups of civil society in the initiative presented in order to achieve significant benefits on behalf of sustainability, according with bottom-up initiatives. Consequently, university, which is a public institution aimed at serving society, is working for answering social needs. In our case, this was possible due to the fact that researchers were at the same time

practitioners, what make evident the importance of the establishment of meaningful relationships, based on trust, respect, recognition and mutual purposes.

Next, this experience is based on a participatory approach, thus stakeholders engaged are involved in all phases: discussing the purposes of the research, disseminating results, participating in teaching spaces and preparing the activities of policy advocacy. On one hand, this process empowers and reinforces social organizations. On other hand, it implies to coordinate all stakeholders with different rhythms, agendas and functioning.

Furthermore, working with groups from social organizations with a lot of experience on the work in the energy field has contributed to the existent debates at university from a critical and activist perspective. This has strengthened the idea of social transformation towards sustainable futures. Additionally, this engagement helps to legitimate those social organizations involved, in front of the society in general.

Nevertheless we are aware of the limitations of this experience, which are mostly related to the difficulty of driving changes in university governance, so as to cement sustainability principles. This requires a long term strategy, coordinated with other areas and departments in university, with a direct link with university responsible of developing sustainable policies. Our bottom-up initiative has not been combined or connected with other top-down policy initiatives, which would have been significantly interesting so as to exploit the synergies and extend the impact. Moreover, the fact that researchers are practitioners as well implies the existence of a bias during the research process.

Considering the lessons learned from the case study and taking into account the limitations of this research, we propose several elements that should be considered in future processes in order to achieve Transformative ESD goals, such as: the inclusion of different stakeholders in an interdisciplinary team, with special links and a collective identity; impulse of grassroots-led participatory processes, which should be designed through the dialogue; considering the wide spectrum of agendas, rhythms and interests; considering social demands and combining them not only with research activities, but also with teaching and services; promotion of initiatives to raise critical consciousness, reflection, changes in habits, attitudes and governance models within universities; an looking for alliances in various areas in the institution in order to combine bottom-up initiatives (with stakeholders from civil society) with top-down policy initiatives (with stakeholders from the level of management in HI).

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An Integrative Framework for Re-thinking 2nd Generation Sustainable Development (SD2.0) Projects, Education and the University as Catalyst

Timothy J. Downs and Nikita Golovko

Abstract

The University is poised to serve as the catalyst for an integrated, multi-sectoral, multi-scale approach that builds the requisite collective social and technical capacities of primary stakeholders to enable 2nd generation sustainable development (SD2.0). A synthesis of empirical evidence will be used to inform and justify a new *integrative framework* to design local and regional-scale projects, informed by the UN's SD21 Sustainable Development for the 21st Century report and the post-Millennium Development Goals (2000–2015) era. It will also be used to situate "education for sustainable development"—the theme of this book—in the integrative framework, to navigate the degree to which other additional components/aspects need to be considered for education to be impactful at the systems level. The framework involves five main axes of integration within which the University's role is shown to be central and catalytic: (1) socio-political stakeholder interests and influences; (2) development sectors (e.g. water, energy, health, food, the economy and climate resilience); (3) knowledge types (scientific and indigenous); (4) socio-technical capacities, including—but not limited to—education, research and information resources;

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and (5) connections among sites with SD2.0 projects, forming an innovation network. This process recognizes integration and social innovation to be primary for success, technology secondary, and education to be but one key component. We argue that this integrative approach does not require a reshaping of the University's primary role—as others have argued—rather an amplification of its commitments and responsibilities. By integrating within and across these five dimensions during the design phase for projects, programs, and formal curricula, a new path to transformational sustainability emerges practical and compelling. Three illustrative examples of SD2.0 work are given.

Keywords
Integration · Capacity building · Socio-technical innovation

1 Introduction

As we prepare to enter the 2nd generation of sustainable development work (**SD2.0**), 25 years on from the first Earth Summit in 1992, critical reflection on what has worked and what has not needs to inform a fully revised approach. The United Nations' own reflection is given in "Sustainable Development for the 21st Century"—the SD21 Project (UN/ESA 2015). Above all, SD21 highlights the need to recognize and engage the fact that SD is "inherently political", and calls for a more central role to be played by civil society and community groups. It also calls for the consideration of multiple sectors that overlap—a multi-sectoral frame of reference—in recognition of the interdependence among sectors/issues/topics, and mindful of the need to be both effective and resource-efficient, especially in the severely resource constrained settings of so-called "developing countries". Likewise, as we enter the post Millennium Development Goals era (UN/EN/ECOSOC 2015; UNGA 2014), and the stark realities of a climate-changing world (IPCC 2014), the same basic recommendations apply. We have created and we inhabit a new geological era marked by the global-scale changes humans have made to the Earth: the age of the *Anthropocene* (Griggs et al. 2013). Thus, how we organize to conceptualize, frame, design, do baseline assessments, plan, implement, and monitor human development projects and public educational programs is at a threshold moment, one that encourages creative, critical, reflective, integrative thinking. This chapter has three goals: (1) to present an integrative organizing framework for SD work; (2) to situate the University centrally within this framework; and (3) to present three case studies—two domestic US (Central Massachusetts) and one international (Fijian Islands)—to illustrate the approach and the University's role. The chapter simplifies the socio-political and technical complexity of SD work in a pragmatic way, and it re-imagines the role of the University as pivotal, almost a thousand years after the first university—University of Bologna—wrote its founding charter in the mid-12th Century.

1.1 Complex, Compelling Context

Domestically in the United Sates we are living through an era of unrivalled political discord and partisanship, while internationally our world is confronting powerful destabilizing forces on three fronts:

- Economically: an unstable, unfettered global financial system beyond the reach of responsible public regulation has placed economic stress on a shrinking 'middle class' and exacerbates the vulnerability of the 'working class' in the US and many other countries.
- Socially: societal unrest in the face of rising social, political and economic inequities, with the gap between the 'haves' and 'have-nots' growing ever wider (recent uprisings like the Arab Spring in Egypt, and widespread public protest like the Occupy Movement in the US are expressions of this unrest and the issues they embody remain unresolved).
- Environmentally: anthropogenic climate change is already adversely impacting the capacity of the agricultural system to feed a growing world population, amplifying drought and wildfires in arid and semi-arid regions (including the South Western US), and driving more frequent and severe flooding in humid regions. More frequent and severe storms—hurricanes and tornadoes—are a likely scenario for the US, in places unaccustomed to such events and ill-prepared to mitigate their effects. At the same time, the burden of toxic chemicals and the risks of exposure to them grow in spite of gains in laws and regulations in the US, and in the absence of adequate protections for the vast majority of the world's rapidly urbanizing population of 7.2 billion.

There is also another global context that needs our consideration in terms of social and environmental changes. In 2007 the world officially became an "urban planet" with the majority of people inhabiting urban settings for the first time in human history. The trend is strongly upward, with the most rapid growth happening in so-called 'mid-sized' cities.[1] Rapidly urbanizing, rapidly industrializing settings in so-called 'transitional' and 'developing' countries are the places where pollution burdens and health impacts, for example, are potentially very large because of inadequate sanitation capacity and environmental regulation (Downs 2001). Such business-as-usual development is top-down, favors elites, and is having adverse impacts on human health and wellbeing (though little is known about their magnitude and extent), as well as accelerating climate change through the emission of greenhouse gases.

[1]The size of a 'mid-sized' city varies by country and needs to be placed in a country context; it is several million people in China for example.

1.2 "Sustainable Development" Versus "Sustainability"

Since the first Earth Summit in Rio in 1992 there has been a struggle to define and enact *sustainable development* and the term '*sustainability'* in a meaningful, practical way; many are disillusioned with the misuse of the term, while at the same time it is being applied as an organizing principle for key US agencies like the Environmental Protection Agency (USEPA), Housing and Urban Development (USHUD) and Dept. Agriculture (USDA), and is used extensively in corporate propaganda. Overuse, misuse, abuse and confusion about the term *sustainability* are both apparent and problematic. On the other hand, it does offer up the opportunity to be aware of these things, and for collaborative efforts and social enterprises/networks to go back to philosophical guiding principles of *sustainable human development*—as distinct from the *vague term sustainability*—that center on social equity (fairness and fair access to resources and opportunities for health and wellbeing) within and across generations, ecological stewardship and integrity, and economic vitality and a much more equitable distribution of the positive and negative impacts of development, and a most favorable tradeoff between the two.

One useful global reference document is the UN's "Back to Our Common Future: Sustainable Development in the 21st Century (The SD21 Project)" (UN/ESA 2015).[2] In preparation for the Rio+20 conference in 2012 it stated: "Knowledge must inform action—knowledge of what has and has not worked for sustainable development in the past 20 years, knowledge as well of important changes and new challenges that have emerged in the past generation. Only on this basis can we develop a clear vision of sustainable development for the 21st century. That vision needs to incorporate and build upon the rich output of various global assessments—including climate change, water, energy, and ecosystems—as well as the policy lessons from experience, respond to the evolving nature of the challenges, and draw upon the latest research on integrating sustainability and development into a common agenda. It also needs to recognize and motivate the contribution of all inhabitants of planet earth." Griggs et al. (2013) argue strongly for a more intentionally integrative SD agenda that combines protection of ecological life-support systems with poverty reduction as twinned priorities.

2 Framework for SD2.0 System Design

Given the aforementioned context, and the opportunities and urgent need for innovation, it is appropriate to pay close attention to the thoughtful, reasoned *design* of SD2.0 projects, in the same way that we would design a new generation of exploration and discovery technology based on lessons so-far learned and new knowledge about human-environment system interactions. Griggs et al. (2013) have laid out six 'Universal Sustainable Development Goals' for the next generation of

[2]See: sustainabledevelopment.un.org/sd21.html.

SD and post-MDG work, goals that cut across economic, social and environmental domains. This re-imagining of the SD science-policy agenda is helpful and clearly calls for an innovative, integrative approach that the University is well positioned to promote and to model. In the climate-change science arena, models of plausible future scenarios are improving all the time: four representative concentration pathway (RCP) scenarios consider the range of radiative forcing values in the open literature, and were compiled through technical collaborations among integrated assessment modelers, climate modelers, terrestrial ecosystem modelers and emission inventory experts (van Vuuren et al. 2011). However, while the science is improving, public discourse and policy leading to appropriate societal responses is chronically weak and under-nourished. One of the most pressing agenda items for SD2.0 and for the University is how to create vibrant integration among science/research, public education, public discourse, policy and concerted action on climate-change mitigation, adaptation, and resilience-building.

2.1 Axes of Integration

Drawing on this global context, empirical evidence from 25 years of SD1.0 work and 15 years of MDGs work, as well as experiential knowledge, five main axes of integration serve as a pragmatic socio-technical framework for integrative SD2.0 work, and possess logical interrelationships (Fig. 1):

1. ***Socio-political stakeholder interests, influences and relationships***—The primary axis of integration is across stakeholder and social actors—especially local ones—recognizing that the relationships among them are governing of success (Downs 2007), that these actors and their relationships are the source of knowledge types that help define and understand complex issues and problems, as well as the source of societal capacity to address them. Unless this dimension is given priority—and it rarely is—simple logic shows SD work will tend toward top-down, technocentric approaches that bias knowledge about, and responses to, issues and problems. Such are the traditional approaches to

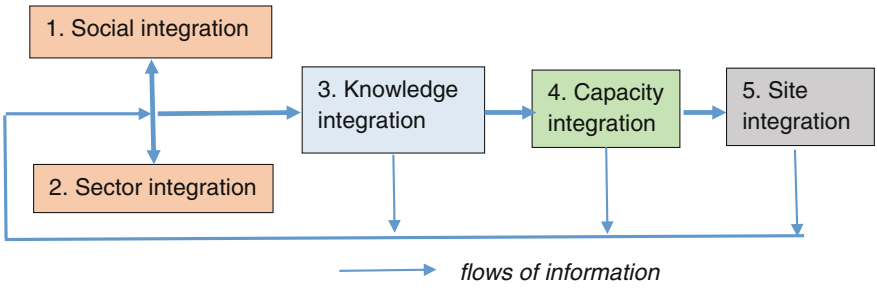

Fig. 1 Simple functional hierarchy of SD2.0 axes of integration. Logic shows that social innovation and integration are governing of success, and technical aspects are secondary

international development and also disaster relief and post-disaster reconstruction, for example in Haiti after the 2015 earthquake.

2. ***Development sectors***—Linking across different sectors, topics and issues—e.g. water, energy, health, food, the economy, climate resilience, social justice—forms the second major axis of integration for SD2.0 work. Sectors and issues tend to be interdependent, often in powerful ways, and comprise complex social, political, cultural, economic and technological human systems. These systems interact with natural environmental systems, often depending on their ecological integrity, and it is this human-environment systems interaction that ultimately governs the viability of sustainable development (Griggs et al. 2013).
3. ***Knowledge types*** *(incl. scientific and indigenous)*—The next axis of integration is at the level of knowledge, 'science', and experience, formal 'ways of knowing' and comprises three main types: (1) Academic knowledge (the domain of the University)—including disciplines in the Social sciences, Natural sciences, Engineering, Management sciences, Law, Information science and technology, the Arts and Humanities; (2) Indigenous and experiential knowledge—derived from ones lived experience, and the shared experience of groups of people often defined in terms of a place and a culture; (3) Professional knowledge—derived from the experience of professional work, including training, skills and competencies.
4. ***Socio-technical capacities***—The ability of societies and communities to conceptualize, understand and address complex environment-development issues and problems, and to imagine and pursue a more sustainable human development path, depends on six levels of capacity (Downs 2001, 2007): (i) political and financial seed capital to initiate and catalyze projects; (ii) human resources, education and training; (iii) shared information and knowledge resources (see 3 above) to understand and respond to problems; (iv) policy making, governance and regulation; (v) appropriate, affordable, technologies and infrastructure (e.g. water supply and sanitation systems); and (vi) enterprise development, especially local provision of products and services to support human health and wellbeing.
5. ***Networking of SD2.0 Sites***—The fifth dimension to inform the design of projects and educational programs, and re-imagine the role of the University—is the connecting together of SD2.0 demonstration and innovation projects at different sites. The value here is that information is shared among projects with a diversity of topical foci and stakeholders, operating with diverse settings and conditions. Such networks are to be encouraged to operate at overlapping scales, from local to regional, regional to national, national to international.

2.2 SD2.0 System

The five axes do enjoy a simple functional hierarchy (Fig. 1): axes 1 and 2 inform and enable axis 3, while axis 3 enables axis 4 and axis 5. Such a model also shows the social innovation aspect to be the driver of integration, and thus governing of success. Feedbacks make the system adaptive. This integrative framework informs all stages of an SD2.0 project: conceptualization, framing, designing, baseline assessment, planning, implementing, and monitoring (that re-informs earlier stages as an adaptive process). *How are these axes themselves connected into a system that can operate at any geographical and/or geopolitical scale?* What is the nature of the 'flows' that connect them? The answer is: flows of knowledge via communication and collaboration. Stakeholders interrelate by sharing knowledge and communicating their ideas, interests and concerns to others; specific sectors and topics also interrelate by sharing knowledge and information; integrated capacity is built by exchanging and leveraging shared knowledge, data and information. The networked system can operate at any scale, and move up and down scales: local, regional, national, international, global. Stocks and flows of information/knowledge form the life-blood of a socio-technical SD2.0 network. They are sustained by vibrant, trusting and mutually beneficial relationships among the network members: the relationships among people are the 'beating heart'. One can argue that this process constitutes education at the level of society—multiple stakeholders—or social learning, and that this is the essence of the dynamics (Downs 2007). Thus, the potential impact of the University on education in this framework extends well beyond its traditional reach of degree programs and research findings, becoming an engine of social learning.

Trencher et al. (2013) have described five 'channels' by which entrepreneurial universities the world over are collaborating with other actors to further sustainability, using empirical data on cases: (1) knowledge management—academics create, process and diffuse knowledge to stakeholders; (2) demonstration projects and experiments for unproven technologies; (3) technology transfer and economic development centered on low-carbon, 'green' technologies; (4) restoration and/or transformation of degraded urban areas; and (5) socio-technical innovation processes, e.g. food system innovation driven by social learning by multiple actors in concert. These channels each have some degree of integration at their core, and social as well as technical innovation processes at work. Each of these empirical approaches can be mapped onto the SD2.0 System which provides a useful conceptual framework for thinking about multiple ways in which the University can model and stimulate innovations.

3 The University for the 21st Century

We pose a basic question, as others are beginning to do: What *is* the role of a "university of consequence" in the 21st Century? In academia, the number of academic programs with 'sustainability' in the name is increasing and market research indicates that it is now a widely-used search term by prospective environment-development students, supplementing the simple term 'environment'. However, to realize its full potential in the SD2.0 domain, a serious re-imagining of roles, missions, structures, programs and processes is called for – and this can be informed by the proposed framework (Fig. 1).

3.1 Re-imagining the University

The word *university* comes from the Latin *universitas magistrorum et scholarium*, meaning "a community of teachers and scholars". Traditionally, the university is an institution of higher (or tertiary) education which educates students and undertakes research. It grants academic degrees in a range of disciplines at the levels of undergraduate and postgraduate study. In the context of sustainable development, and other priority areas of societal concern like climate change impacts and responses, and health problems and health care, the university is uniquely positioned among stakeholder groups because of its relatively unbiased role as multi-faceted societal educator and researcher. Universities the world over are beginning to re-think their traditional role in part because they are attempting to be more competitive for students in the higher education marketplace and research dollars from grants, but also in an attempt to amplify their impact on society and the complex issues of our time. There are two main complementary ways that the university can evolve and be more impactful: (a) look internally at the development of more integrative, impactful degree programs and professional certificate programs, ones that focus on understanding and responding to complex issues of the 21st Century; (b) look outwardly to work in partnership with other societal groups—community based organizations, non-profits, public agencies, policy makers and businesses. There is a discernable global trend for the University to collaborate with government, industry and civil society on sustainable development issues—to "co-create" sustainability transformations—and for the mission of such entrepreneurial institutions to evolve in step (Trencher et al. 2013). In essence, *universitas* simply (in theory at least) needs to be re-imagined to create more integrated 'whole' learning experiences on campus and off-campus—focused on understanding and responding to problems/issues. Faculty from relevant disciplines, using inter-disciplinary frames, should design environment-development programs and curricula to involve more students in practicums, team research projects, and community-centered pilot projects that are strongly and inter-connected with a diversity of stakeholder groups.

3.2 University Roles for SD2.0

The last decade of the 20th century was predictably productive for new theories and approaches re-imagining the role of the university, trying to describe and explain a new social contract between the university and society. These attempts included: (a) a new vision of knowledge production called *Mode-2 Science* (Gibbons et al. 1994); (b) the importance of university–industry–government partnerships called *Triple Helix Theory* (Etzkowitz et al. 1997); (c) the adaptation of a corporate-style culture inside the university called *Academic Capitalism* (Slaughter and Leslie 1997) and (d) a set of "empirical" parameters (like the strengthened steering core, the expanded developmental periphery, etc.) that characterize the *Entrepreneurial University* (Clark 1998). However, none of these theories were developed in the context of sustainable development and the integrative power of the university.

In this context, we can stress one significant change to how we understand the attitudes and roles of stakeholders. Within the *functionalism* perspective (e.g. Stinchcombe 1968), the realization of a common societal goal is impossible without adequate attention to the functional roles stakeholders play. What can be argued herein is not the need for the redistribution of such roles, rather the need for an amplification of stakeholder "zones of commitment and responsibility" related to the human-environment domain. This disagrees with the common understanding that we should change those roles or redefine them in order to engage with important emerging topics, like SD or climate change. Using our integrative approach, the functional roles of stakeholders essentially remain the same: the role of the university is still primarily to provide education and conduct research. What we argue is that the *commitment* not the role be re-imagined in the context of an integrative SD2.0 framework. This approach has already made innovations in pedagogy, for example helping students choose among courses according to their interests and direction, involving them in use-inspired research, etc. The contemporary professor is now as much a facilitator and helper as she is a teacher. She is still (and always will be) an expert in the field, but her "zone of responsibility" has extended. Students are now not only recipients of knowledge, but also active self-learners who model the practical impacts of higher education. From this perspective the new ethos of the university is composed and shaped corresponding to the changes in the original "commitment setups" of all the stakeholders in question. Moreover, we argue that the very idea of an integrative SD2.0 System is to inform a constructive change in commitment setups, in terms of the axes of integration.

Much has already been written about new roles for the university: innovation driver, catalyst and knowledge creator/integrator, or the partner providing technical and research support. During the first generation of SD work—SD1.0—we argue that the university was mainly considered in terms of the functional roles that it was supposed to play in the sustainable development context. However, within the SD2.0 frame the university is considered in terms of the quality of "commitment setups" of primary stakeholders. How do we gauge quality? Each stakeholder occupies a space within the multi-dimensional frame (Fig.1) and we can compare

Table 1 Comparing the university with other actors in an integrative framework

Actor	Axes of integration from Fig. 1				
	Social actors	Sectors	Knowledge	S-T[a] capacity	Sites
Business	L (L)	L (L)	L (L)	L (L)	L (M)
Government	M (M)	M (H)	L (M)	M (H)	M (H)
Donor	M (M)	L (M)	L (M-H)	L (M)	M (M-H)
Non-profit	L (M)	L (L-M)	L (L-M)	L (L-M)	L (L-M)
Civil society	L (M)	M (M)	L (L)	L (M)	L (M)
University	M (H)	M (H)	M (H)	M (H)	M (H)

The level of existing and (desirable potential) capacity to integrate in these five domains: H high; M moderate; L low. Assumes that all entities are nominally interested in innovation for sustainability, collaborative work, and the building of their capacity. The University is the only one with M (H) across the board.

[a]Socio-technical, aspects of social and technical innovation that interrelate to each other

this space with what is both desirable and reasonable to expect in terms of integrative potential (Table 1).

The university is uniquely positioned within stakeholder dynamics and politics – see its Table 1 ratings of M (H) across the board – because in most cultural contexts it is relatively neutral politically (in terms of its positions and the exercising of its power), is generally regarded with respect and as an independent thinker, and often expounds a mission embracing of the values of sustainability and social justice. Formative for SD2.0, from 1998 to 2000, Downs worked with the United Nations University's International Network for Water, Environment and Health (UNU/INWEH) in Mexico to facilitate and promote sustainable water supply and wastewater sanitation systems in three pilot cities (Downs 2001). The project brought together diverse stakeholders and built trust and a shared vision where they would not otherwise have existed because of a predominance of mistrust and a prevailing model of non-productive, even conflictual social interactions. The project worked well for three reasons: (1) the UNU was seen as an independent, trustworthy, and well-qualified facilitator/promoter; (2) the issues of water and wastewater were a shared priority with stakeholder interests converging on the sustainability of the sector; and (3) the project was framed positively as a capacity-building social enterprise in which participants' contributions were valued and the benefits of knowledge integration and mutual capacity building outweighed the costs.

4 Illustrative Cases

4.1 Holliston Health Project, Central Massachusetts

We advocate placing *human health and wellbeing* at the core of SD2.0 work especially *children's health and wellbeing* because they are fundamental to human development, and resonate with all stakeholders. The Holliston Health Project (H2)

began in Fall 2013 when concerned mothers came to Clark University to share their concerns that pollution in the Town of Holliston, Massachusetts, may be contaminating local groundwater used as the municipal drinking water supply source, and affecting the health of their children, neighbors and community members. Researchers were inspired to collaborate to explore these concerns scientifically. Thus, H2 was begun, and has been designed and developed as a *community engaged/community based participatory research (CEnR/CBPR) project*—an approach which is also entering its second generation of practice, is well established but has room to evolve, and is being increasingly recognized as desirable by major public health and environmental agencies like the U.S.National Institutes of Health (NIH) and the US Environmental Protection Agency (USEPA). Preliminary research showed 4–6 pollution sites acting as legacy and existing sources of about 15 toxic chemicals of interest, and health issues (mainly anecdotal to date) ranging from cancer and neurodevelopmental issues to birth defects and chromosome abnormalities (Trisomy 18, 21). The technical complexity of potential environmental exposures to chemicals and the health implications, coupled with a classic social complexity of non-productive interaction between concerned residents and town officials (officials assume a defensive, dismissive posture in the face of citizens concerned about the water supply) informed the design of H2 as a multidimensional, multi-stakeholder adaptive research-meets-action project (M2ARA). The design facilitates the coupled goals of: (a) understanding if exposure to polluted drinking water is associated with adverse health outcomes; and (b) if it is, comparing alternative solutions to the problem. We prefer the term "multidimensional" to multi-disciplinary because it connotes looking at a complex issue from logical vantage points determined by the issue itself rather than forcing disciplinary lenses onto the issue. In this way, the 'whole' is revealed, the problem drives the analysis, and a better model of what is happening is crafted. The "adaptive" aspect is important because issues and problems are dynamic and societal responses to them need to be adaptive to changes in contexts and conditions. The part of the label "research-meets-action" acknowledges that there needs to be a feedback loop between science and policy so they inform and re-inform each other.

M2ARA is an example of using the integrative framework to design a health-centered SD project, and it also illustrates the pivotal socio-technical innovation role and catalytic role of the University in the face of a complex human-environment issue. At the beginning, when researchers listened carefully and respectfully to impassioned community concerns, and throughout collaborative project development, the University represented itself as a knowledge resource providing technical support, as well as a social actor who could potentially engage productively with all stakeholders and help align the interests of groups of residents (those concerned, those unconcerned and those neutral), town officials, and local, state and national public agencies of public health and environmental protection. H2 exemplifies the driving influence of the two primary axes of integration for SD2.0 work: (1) Socio-political stakeholder interests, influences and relationships; and (2) technical sectors/issues. Interdependencies among key sectors (axis 2) are becoming obvious to all: drinking water systems engineering, how drinking water

wells alter groundwater flow, the environmental dynamics of pollutants (incl. whether supply wells capture plumes of pollution), industrial activities as sources of pollution, exposure scenarios and health risks, public policy and regulation where public health and environmental protection intersect. The third axis of integration—(3) Knowledge types (incl. scientific and indigenous)—rounds out the primary influences on the project design and deployment. Paying attention to these first three axes of integration drives the fourth—development of socio-technical capacities to understand and respond to problems in an adaptive fashion presently, and going forward.

4.2 Sustainable Agriculture, Central Massachusetts

In another example of placing human health and wellbeing at the core of SD2.0 work, Clark University is the innovation driver, catalyst, enabler and knowledge creator/integrator for a partnership to further sustainable agriculture and food systems in Central Massachusetts. The main partners are: Central Massachusetts regional Planning Commission (CMRPC), a public regional planning agency with an agriculture and transportation focus; Regional Environmental Council of Central Massachusetts (REC), a community-based organization with an environmental justice and food security focus; and Lettuce-be-Local (LBL), a non-profit with a focus on promoting the production and consumption of healthy, locally grown organic food. The partnership is working to assemble secondary data on regional-scale food production, distribution, and consumption, and is creating an interactive information resource using cloud-based GIS. The goal of the work is to understand the existing food and agriculture system (baseline or business-as-usual scenario), and its relative social, economic and ecological sustainability, and to compare it—using those same sustainability indicators—to alternative system designs that increase the connectivity among producers, distributors, retailers and consumers. Results so far reveal very low supply-chain connectivity exists and very low sustainability, with many large-scale consumers (10 colleges and universities, 2 major hospitals, and a growing biotechnology sector) in the City of Worcester (population 180,000 in 2010), sourcing almost all their food from outside the region. This occurs despite the fact that the Central Massachusetts Region has one of the highest densities of small and mid-sized organic farms in the US (USDA 2015). Sectoral integration is happening, with explicit interactions being explored among the following: food and agriculture; public health; water resources; ecology; climate change; transportation; energy; local and regional livelihoods and economies. All five of the axes of integration are being used as the organizing framework for project design and execution. Among the socio-technical capacities, Seed Political and Financial Capital (capacity i of axis #4), is being built in the form of grant-writing and applications for funding. In some of these applications, the University is the lead applicant (e.g. in federal research funding), while in others

CMRPC, REC or LBL are the lead applicants, with the University as the partner providing technical and research support.

4.3 Climate Resilience Project, Fijian Islands

To illustrate the international context for SD2.0/Climate-Change Resilience using this approach, we turn to the Fijian Islands. For the past decade or so, Fiji has been experiencing more frequent, intense flooding each year, representing a significant change in their weather and climate. Island nations are among the most vulnerable places on Earth to the adverse impacts of climate change and climate instability, because of inundations from sea-level rise, flooding from intense, prolonged precipitation, and from severe storms that wreak havoc on populations, vital infrastructure and settlements (IPCC 2014). The good news is that development funders like the UN, World Bank, Asian Development Bank, European Union and others are making *climate-change resilience* a priority. However, at the same time more funding is being made available to island nations to become 'climate-change resilient', this is exposing the urgent need to build sufficient socio-technical capacity (axis #4) to design and execute resilience projects that can work and be adaptive to highly dynamic and uncertain conditions. As always, the first task has been to understand existing approaches to development (incl. governance), development sectors and socio-technical systems (food, water, energy, transportation, health/EMS, telecommunications, flood mitigation, disaster preparedness and response etc.) and their relative resilience/sustainability. In addition, climate-change scenarios of the future and recent climate data are being used to better come to terms with climate stressors that have occurred or are likely to occur, even though exactly when and at what precise intensity are irreducibly uncertain. This can be thought of as the *envelope of plausible futures* to which Fiji needs to become more resilient, where climate resilience is being defined as: the ability to bounce-back from climate shocks to the system, to mitigate, avoid and/or reduce adverse impacts.

The Fiji case exemplifies the need to integrate socially, technically, and across sectors to build a socio-technical system with sufficient climate-resilience capacity at the scale of the whole nation. The kind of SD2.0 System shown in Fig. 1—integrating across stakeholders and sectors in each location, and across locations through knowledge cores (capacity iii of axis #3)—represents such an innovative SD2.0/Climate Resilient system design. Presently, as in many places around the world, development projects tend to be top-down, single sector/issue based, not networked and driven by technology, leading to a fragmented compromised socio-technical system with inherently weak resilience and sustainability. In economic terms, this means that development funding is not being used in ways that yield cost-effective, sustainable solutions to complex socio-ecological problems that have major social, economic and ecological implications. Funding is not the limiting factor in these cases, it is the inability of donors and recipients to think and act

in sufficiently creative, integrative ways. The roles of the University as innovation driver in this context are essentially the same as before—catalyst, enabler and knowledge creator/integrator—but there is a particular emphasis that needs to be placed on its socio-political role in bringing donors, policy makers, agencies, civil society and local communities, and businesses together to create innovation networks. Given the socio-political complexity of development policies, programs and projects on a global scale—which the Fiji case exemplifies—the most effective driver and catalyst for such SD2.0/Climate Resilience work would be a *core partnership* comprising the University (or a focused network of colleges and universities), the Donor(s), Government Agencies, and a new generation of NGO—NGO2.0—that has a socio-technical integration mission (and networks with the NGO and CBO community).

5 Conclusion

A 'university of consequence' in the 21st Century must carefully and strategically consider its role in how society understands and responds to the inherently complex challenges and opportunities for 2nd generation sustainable development—SD2.0—in an unstable, climate-changing world. The University's traditional role of educator and researcher needs to be amplified, not fundamentally changed, because no stakeholder group is better qualified to play the crucial role of catalyst and facilitator of SD2.0 innovation work, knowledge integrator and translator, and connector among diverse stakeholder interests and capacities to create socio-technical innovation networks. Five axes of integration serve as a useful organizing framework to frame, design, deploy and assess SD2.0 projects: (1) socio-political stakeholder interests and influences; (2) development sectors/issues; (3) knowledge types; (4) socio-technical capacities; and (5) connections among sites with SD2.0 projects, forming an innovation network. Thus, the University's role also extends to project designer—in partnership with other key actors in civil society, non-profits, public policy and the business sector. Perhaps the most important contribution it can make, however, is exercising the creative imagination of its faculty and students to exemplify the underlying principles of sustainable development—integrative social justice, ecological stewardship and economic vitality—and to demonstrate that paths to a sustainable future are both compelling and practical.

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Student Work Placements as a Focus for Building Partnerships Between Universities and Sustainable Development Stakeholders

Gill Davidson, Peter Glaves, Richard Kotter and Justine Wilkinson

Abstract

The Department of Geography at Northumbria University has run a successful (and expanding) work placement module for a number of years now, which seeks to work with external partners and stakeholders to enhance employability of prospective graduates, and to contribute to the capacity of the partner organisations in terms of selected mini-projects. These are flexible in set up and execution, but with a required report output for the placement host, as well as a reflective portfolio for assessment of the students. A significant strand has been on sustainability projects, including green travel surveys, biodiversity mapping, marketing, and feasibility project research, working for instance with business parks, social enterprises and logistics companies. This paper reviews the key methods of engagement with these partner organisations, and the way that students are selected, placed, coached and assessed. It identifies some of the challenges and risks involved in the process, and critically explores how even small exploratory and applied projects can make a difference regarding engagement by a university department with external stakeholders at city/regional (and beyond) and societal level, and effectively foster

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understanding through a reflective process of student learning and assessment of the nature of environmental, social and economic challenges in promoting more sustainable practices in cities and societies.

Keywords
Higher education · Employability · Sustainable development · Work placements · Partnership · Reflective learning

1 Introduction

This paper seeks to review the key methods of engagement by Northumbria University's Geography department with our partner organisations in the context of a work placement module, including the way that students are selected, placed, coached and assessed. The paper reflects on the challenges and risks involved in the process, and critically explores how even small exploratory and applied projects can make a difference regarding engagement by a university department with external stakeholders at city/regional (and beyond) and societal level. We conclude that the module and this mode of engagement with our partners effectively fosters understanding of sustainability and workplace environments through a reflective process of student learning and assessment of the nature of environmental, social and economic challenges in promoting more sustainable practices in cities and societies.

Equipping undergraduate students with the skills and knowledge to find a graduate-level job upon completing their degree, as well as then establishing themselves on a career journey, is a key underlying goal for universities. However, this goal is not always fully realised:

> More than half of major employers [in the UK] say that the graduates they hire are not 'work ready' on leaving university. Communication skills, teamwork, resilience and punctuality are among the attributes employers want
>
> (Research conducted by YouGov with 635 UK employers) The Times, 2013

The UK's Leitch Review (2006) on future skills needed for employment and competitiveness needed for "UK plc" underlined the importance of offering opportunities in higher education for students to develop 'job related skills'.

> We cannot call to mind any psychological text that commends one-off skills development units and recall that many say that 'skills' are best developed by being applied to a range of worthwhile material. Skillful practices are best developed across a whole programme in order to provide practice, reinforcement and opportunities to apply those practices to different content through increasingly authentic tasks.
>
> Knight and Yorke 2004: 43

'Employability' is a contested term used in a range of contexts (Hillage and Pollard 1998). Supporting this notion, Philpott (1999) describes employability as a 'buzzword' which is often used but which is interpreted in a number of different ways, and Gazier (in McQuaid and Lindsay 2005: p. 197) states employability is *'a fuzzy notion, often ill-defined and sometimes not defined at all'*.

Yorke and Knight (2006: 3) define employability as:

> A set of achievements – skills, understandings and personal attributes - that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy.

Dacre Pool and Sewell (2007) suggest that the commonly held view of employability as being about securing a job or merely developing a number of individual skills is rather simplistic, and falls short of the real dimension (including in terms of career trajectory and lifelong learning).

> …employability goes well beyond the simplistic notion of key skills, and is evidenced in the application of a mix of personal qualities and beliefs, understandings, skillful practices and the ability to reflect productively on experience.
>
> Higher Education Academy Online (n.d.)

A number of models have been developed to attempt to describe and explain the complex range of factors that may influence employability (see e.g. Knight and Yorke 2004; Kumar 2007; Dacre Pool and Sewell 2007); these include commonly understood variables such as knowledge, understanding and skills, as well as variously emphasising less tangible qualities such as meta-cognition and self-theories (Knight and Yorke 2004). Dacre Pool and Sewell (2007) place high value on emotional intelligence factors such as self-esteem, confidence and self-efficacy, suggesting that reflection and evaluation of one's performance may be key to developing such attributes. The Northumbria University's Geography work placement module builds on this theme by encouraging students to evaluate and reflect on their own performance on placement.

2 The Work Placement Module at Northumbria University

The Geography and Environment work placement module aims to provide final year degree students with the opportunity to review, evaluate and build upon the skills and knowledge that they have attained during the programme by applying them in a workplace environment. The module also introduces students to a range of career development and management skills, encourages them to begin applying these, and enhances their job seeking preparedness. By the end of the module students should be able to meet, and are assessed against, the following learning outcomes:

- Reflect on their subject-specific and graduate knowledge base and demonstrate a critical awareness of the practical relevance and provisional nature of this knowledge;

- Critically evaluate their current skills and knowledge and map these to the skills and knowledge required within future careers in their subject area;
- Apply their subject-specific and graduate skills to the world of work and make clear linkages between theoretical, professional and practical application of such skills in the work context;
- Develop and apply their practical subject-specific skills to the range of contexts which apply within the work/organisational/industry situation;
- Demonstrate their autonomy but also team working skills in applying subject skills within the work place;
- Self-evaluate their transferable career skills, including: teamwork; initiative-taking/leadership; communication; analytical skills and problem-solving; independent working; and having a professional and responsible approach to work.

The module is an increasingly popular year long optional unit of the undergraduate degree programmes in Geography and Environmental Management, and is split into two main parts: semester one involves a taught programme focusing on employability and career skills, and incorporates the process of allocating or finding and securing placements; and in semester two students carry out their placements.

Semester one course materials are designed to encourage students to engage with the process of applying their subject-specific learning and knowledge, alongside the skills they have developed through other means, which may also be extra-curricular within the university (as course reps and in the Students Union) or gained outside through part-time jobs or volunteering. This includes the higher order transferable skills that are valued by employers. At every step, students are given time to reflect and to enable them to build a bank of personal examples to draw upon during the typical application process. They are encouraged to reflect on their own values, strengths, skills, preferences and achievements as a key part of the career development process.

The taught programme begins by introducing students to the range of career choices a degree in Geography or Environmental Management may lead them to. They are encouraged to think about their own aspirations and preferences, and are provided with information that may help them to make career decisions, such as destinations of past graduates (including by an annual departmental Careers Day with both employers and Alumni presenting), the nature of various occupations and organisations, and what skills are highly valued by employers of differing natures and industries (private, public and third sector). They are also given the opportunity to evaluate their own skills and strengths through psychometric testing and skills identification activities. Sessions go on to consider job seeking activities and strategies, and sources of support. For instance, students are encouraged to develop a CV and to practise writing covering letters and completing application forms targeted to specific roles, as well as taking part in interview practice. Staff teaching the course have developed a range of student-centred activities to enable students to practise and gain experience in key types of activity.

Students participate in a 'making your skills and experience count' exercise, which involves articulating and sharing their own examples. They are divided into pairs. Student 1 is given a card showing a key skill, e.g. teamwork, and asks Student 2 to provide a specific example showing their ability relating to this skill. Student 2 has two minutes in which to do this, after which Student 2 moves to a different table where he or she will be asked about a different skill.

Student 1 must actively listen to Student 2's response, and at the end of the exercise is asked to share the best responses they were given with the group. The exercise provides students with thinking time and the opportunity to share examples with their peers, and gives them practice in articulating responses to questions, which increases their confidence and ability to do this.

Example activity: speed dating for skills

3 Completing the Work Placement

Students on the module must undertake a short work placement lasting for at least 70 hours or 10 working days, arranged and executed in a flexible manner to suit both the host organisation and the student. This is usually—but not always—carried out during semester two, following the taught programme in semester one.

The aim of the placement is to provide a relevant, academically credible, work-based learning experience. The student is expected to show significant development in core transferable skills and therefore increase his or her chances of finding rewarding employment after graduation. Students submit a final assignment which reflects on and evaluates their placement and how it has influenced their knowledge, skills, and future career plans and aspirations. Figure 1 shows the range of skills which students must demonstrate through their placement, and which are they are assessed for (with some input from the workplace supervisor at the host organisation and the assigned academic university supervisor who oversees the placement and communicates with and visits—in person if possible or otherwise virtually—the host organisation).

Part of the taught element of the module is dedicated to helping students find placements. This is managed in one of two ways: by seeking out placement opportunities and asking students to apply (competitively if there are several suitable candidates) for them, and by encouraging students to find their own placements. Both routes involve equipping students with traditional employability skills such as CV writing and practising interview techniques, and the latter also aims to enable students to seek out opportunities; it is taught in combination with job searching activities. The rest of this section will describe the former process.

Department staff work with external organisations in a number of ways, whether this is through conducting research, organising teaching activities such as field trips and visiting lecturers, or through more strategic partnering activities. Northumbria University is committed to this style of working, with its Corporate Strategy stating

Upon successfully completing the placement, the student will:

1. Demonstrate an in-depth knowledge of what the employing (placement) organisation does.
2. Demonstrate an understanding of how the organisation is structured and managed.
3. Demonstrate an understanding of the economic, political/social and environmental context in which the organisation is set.
4. Gain theoretical knowledge applicable to their placement and demonstrate how this has been applied.
5. Gain practical skills appropriate to their placement and their degree.
6. Develop the ability to evaluate and reflect on their own learning.
7. Develop skills of communication, co-operation, self-reliance and self-expression.
8. Develop confidence in visual, oral, written and data presentation skills.
9. Develop other personal skills, as negotiated and set down in the learning agreement.

Fig. 1 Work placement learning outcomes

that '*Partnership working…creates mutual gains in reputation and sustainability*' (Northumbria University 2013). For staff working on the module, securing placements can be a key way to develop and cement relationships with partner organisations they come into contact with, but can also be a result of those collaborative relationships. The potential benefits of taking on a placement student can include having an additional resource to help with the overall work of an organisation for specific tasks or projects, and current students may also have useful skills and knowledge, or provide a new and different perspective on day to day operational issues. Figure 2 shows an excerpt from a letter routinely sent out to potential placement providers, which shows how these potential benefits are presented to employers.

Once an organisation agrees to take on a placement student, staff work with them to customise and draw up an 'advertisement'/brief. This is usually a brief description of what type of work the placement will involve, and a short list of key

'Is there a geography or environmental issue that your company/organisation needs to address or a project that you would like to undertake, but you just don't have the staff resources or time?

'Perhaps a work placement student would be the answer.

'We have a number of final year students studying for degrees in geography and/or the environment, and are currently looking for unpaid ten day work-based placements.

'Placement students can be taken on to work on a specific project or to help with the general work of an organisation. Students may have useful expertise, e.g. GIS, or may be able to provide an extra pair of hands in tasks which require more manpower. Student placements should be mutually beneficial for both the host organisation and the student.'

Fig. 2 Excerpt from a letter sent to partner organisations promoting placements

attributes that the ideal student will possess, e.g. that they will have particular skills, experience or interests, or will have completed specific modules. The advertisement is then posted on the e-learning portal for the module, and at the same time is automatically sent by email to all students on the module. Instructions for applying for the placement are also given; the usual process is to submit a tailored CV and covering letter to the module tutor by a specific date. The module tutor then collates applications and passes them on to the placement provider. Placement providers have free rein regarding their selection process, although the module tutor does offer help with this process, if needed. Organisations typically screen the applications for relevant attributes and then invite some or all of the applicants to an interview; this may be anything from a short chat to a formal and competitive interview process. This strategy for allocating students to placement opportunities aims to reflect real world practice, thus providing students with useful experience and skills relating to job seeking.

The work placement is an optional module which is open to all students in the Geography Department; this includes students of physical and human geography, environmental management, and crime science. The range of potential careers open to such students is very wide and varied, and this means there is a requirement to make links within a wide variety of industries and organisations in order to provide a suitably broad range of placement opportunities. Students taking the module have done placements in a range of work areas (see Fig. 3 for some recent examples).

Environmental surveys	Local Authority contaminated land team	Renewable energy
Marketing agency / music festival organisation – from local authority to independent company	Health and safety teams in private and public sector organisations	Ecology consultants
Hospital waste management	Social housing providers	Environmental projects
University research assistant in Geography & Environment	Property management	Public health
Local Authority planning department	Sustainable energy	Wildlife charities
Zoological gardens	Government environment agency	Recycling and waste management
Recruitment agencies	Forestry Commission	High street retailers
Heavy industry	Third (non-for profit / / charitable) sector organisations	Environmental consultants
Accountants	Catering industry	Fashion industry
Logistics company	Public transport company	Wholesale & automotive industry

Fig. 3 Examples of types of placements undertaken by students

Examples of recent work placements completed by students on the module include one undertaken at an environmental education centre run by a local charity in Tyne and Wear. The student was tasked with organising an improvement to the nature site at the centre, and came up with a plan to create a new path on the site. Over the course of the ten week placement, during which the student attended one day per week, he liaised with the staff, helped write a successful funding bid, sourced the materials—some new and some recycled—and planned the project to completion. The path was completed during a volunteer action day, with the student in a project management role. Another placement involved two students working together to undertake a diversity study on a former greenfield site which now hosts a business park on the outskirts of Newcastle upon Tyne. The students carried out environmental surveys, consulted with staff working on the site and helped organise events to raise staff awareness of the need to protect, nurture and appreciate the business park's external environment, which includes a wildlife corridor, a letch, birdboxes, a dovecote, feeders and hedgehog houses. The placement culminated in the students presenting a report of their findings, which included detailed plans for creating a wildlife walk, wildflower meadow and duck pond, along with budgetary and fundraising strategies. Another one produced employee green travel plans for a business park as a team of consultants (https://www.northumbria.ac.uk/about-us/news-events/news/2013/05/students-guide-the-way-in-environmental-initiative/).
A further recent innovative initiative saw Nothumbria staff, placement students and a collaborating social enterprise (the Skill Mill Ltd) train former young offenders to protect the environment and give back to their communities (in the sense of restorative justice) by carrying out water and land management projects such as stream clearing, which helps to reduce flood risks, winning two national awards (https://www.northumbria.ac.uk/about-us/news-events/news/2014/12/make-mine-a-double-innovative-eco-project-wins-two-national-awards/).

4 Evidence of Success

The potential benefits of doing a student placement include building on one's skills and work-related experience, creating or bolstering one's employment record, developing transferable workplace skills and a 'work-ready' approach, and the opportunity to get to know people currently working in one's chosen field—who may be able to provide references, job opportunities or useful introductions. It is also worth noting that for some students it has confirmed that certain industries/occupations/types of organisations are not for them at this stage of their journey which is also useful in terms of not making a turn which is not beneficial for them at this stage in their graduate destination.

The success of the work placement module is measured in two key ways: by asking the students to evaluate the module, and by inviting placement providers to give feedback on their experience of hosting placements.

Process evaluation is conducted at the mid- and end-points of the year for each cohort of students. Students give their views on the module workload, learning and teaching, assessment, support and advice provided and overall satisfaction. Students are asked to comment on the positive aspects of the module and responses reflect the practical interactive elements with comments including:

'Helped me to gain a better understanding for job applications'

'Got me excited about being part of a working environment'

'Helped identify key skills'

'I liked how interactive it has been rather than all lectures'

Students were also asked to highlight areas for improvement with comments varying on practical arrangements for example:

'More CV work earlier on'

'Most sessions could be shorter'

Some students were keen for longer placements and more specific sector targeted information:

'Possibly complete longer placement and have this as the main assessment'

'More about specific industries'

Representatives of employers that took on placement students in 2013–2014 made a range of comments relating to the ways in which the students had assisted them. A key benefit for many was simply providing an extra pair of hands and enabling more work to be completed, as shown by the following comments:

'Having a student within our team has been very worthwhile and has helped spread some of the heavy workload out team is faced with'.

'Although extra line management and briefing needed to take place, the benefits (student) brought to our organisation outweighed the initial additional work'.

'Students allow us to complete projects that ordinarily we would not have enough capacity to do'.

Students were clearly given important tasks in some cases:

'The placement student has undertaken a review of several management plans which is a key target for our team'.

Placement providers praised the quality of work:

'Quality of work produced was to an excellent standard which has helped the sustainability team in their works'

Some were also able to provide expertise which the placement providers did not possess, or to contribute new ideas or approaches:

'(Student) offered a positive contribution during her placement, especially because of her knowledge of social networking which was all very new to us. (Student) created and launched our Twitter, Facebook and Linkedin company profile'.

'The student helped complete tasks which required a geography background and degree level education, and provided a 'fresh' approach to tackling tasks'.

Independent working was prized by placement providers:

'The skills involved in being able to develop, plan and deliver a valuable piece of work independently are tremendously beneficial for our organisation'.

Employers gained skills from the placement too:

'The placement allowed staff to have the opportunity to gain experience in supervising and mentoring a student'.

There were also some comments about the nature of the placement and how well it had worked within the respective organisations involved:

'Specific projects are best for both parties, allowing independent work alongside attending day to day site visits and meetings to get a feel for what it is like to work in this role'.

The project-based approach gave both the employer and student something to work towards'.

'The student was able to work largely independently and did not require too much officer input'.

'By planning in advance we try to give the student the opportunity to explore various applications of sustainability in the workplace both in terms of energy and waste. We took a flexible approach rather than a single project. This approach is to give the student an appreciation of all aspects of our sustainability work'.

5 Graduate Destinations

The module aims to equip students with the skills and knowledge to support the transition from University to employment. The UK's Destination of Leavers from Higher Education (DLHE) database (which is somewhat limited in that it captures destination in terms of post-graduate work or further study only after 6 months, and as such is no measure of delayed success, a gap for whatever reason or indeed career mid-term velocity) is used as a measure of the employment status of students approximately six months after graduation. Although the data is gathered by the University, the survey and methodology is laid down by the Higher Education Statistics Agency.

In 2013/14 93.7 % of Geography and Environment graduates from Northumbria were in employment or further study six months after graduation. Unemployed levels have fallen by 1.9 % points from the previous year to 5.3 %, graduates into

professional employment has increased by 2.7 % points to 54.2 %, graduates entering graduate level further study has increased by 1.7 % points to 12.1 % and average graduate salary is £19,139, up 11.1 % on last year. Geography graduates are employed in a wide range of sectors, including the public sector, education, commerce, industry, transport and tourism. Examples of job roles that graduates have moved into included a range of management roles, GIS analysis, property consultant, resource planner and Housing Assistant.

Anecdotal evidence gathered by module teaching staff suggests that for some students, taking part in a work placement can be instrumental in helping them gain employment after graduation. This was the case for at least four students who did the module in 2013/14, and at the latest count, three students in the following cohort of 2014/5 have been offered jobs by their placement providers. In other cases, students have been offered the chance to apply for jobs when vacancies have arisen, or have been informed that their details will be kept on file in case this happens. Students have also been asked to extend their unpaid placement in other cases; while this is not as good as getting a job, it can mean that students are able to consolidate and extend their learning, add to their CV and, arguably, ensure they are in the 'right place' if any paid job vacancies do arise.

The placements can also enable employers to gain a favourable impression of the quality of Northumbria Geography & Environment graduates, while making students aware of their organisational activities at the same time. For example, an environmental management company based in the North East took on placement students for several years running. When a vacancy in the company became available, a recent graduate from the Geography Department—who had not been on placement there—applied for it and was successful in getting the job. A representative from the company said their confidence in making the appointment partly arose from their knowledge of the quality of Northumbria's Geography & Environment graduates.

6 Challenges

Sustainability is a key issue for the work placement module, as it in a concrete, applied and reflective way addresses the challenges for the Department to address the sustainability curriculum challenge in an integrated and rounded manner (Cullingford and Blewitt 2004).

Since the module was first developed several years ago student numbers have risen each year, going from around 30 students in the first intake to 105 in the most recent one. This has meant that staff workload has risen—for instance, with regard to coaching and supporting students as well as marking assignments and debriefing students as well as partner organisations—and crucially, more and more placement opportunities must be found. This can be a very time-consuming process for staff, particularly at the early stages when employers may be uncertain of the potential benefits of having a placement student, and what it might entail, meaning that staff can spend hours discussing potential placement ideas.

As a result of increasing numbers of students, increasing emphasis has been placed on encouraging students to find their own placements, and equipping them with the skills to do so. While this can be an excellent way to ensure students act on their initiative and take responsibility for making their placement a success, it can mean that the link between the employer and the University is less well developed (which may have some implications for the formal risk assessment and insurance due processes to be explained and compliance to be established).

Once an individual employer/host has decided to take part in the placements programme, this can lead to a lasting mutual arrangement during which several students are placed with them over a period of years. This can be mutually beneficial, providing the employer with a steady stream of useful (wo)manpower at busy times, while enabling the department/university to place students, allowing a two-way communication and the potential to develop additional partnership work. However, contacts with organisations may be precarious. If a specific member of staff leaves the organisation or goes off sick, then the link may be threatened or lost. This can happen at crucial times: one student was accepted onto a placement, only for the member of staff arranging it to fall ill and take time off work, leaving the student with no point of contact.

Although organisations can benefit significantly from taking on a placement student in terms of overall productivity, it can be challenging for key staff to find the time to plan the placement and provide the student with adequate supervision and mentoring. As one recent placement provider commented, '*It takes up quite a lot of time and energy*'. Many organisations that have provided placements in the past have suffered resource and staffing cuts in recent years in the context of recession and then ongoing austerity, especially in the public but also the third sector—with local authorities in the North East of England being a good example of this—and the remaining staff may find themselves too stretched by their existing role to consider adding to their workload even nominally by hosting a placement.

One employer made an important point linked to this, regarding the range of tasks placement students may be asked to take on, and how vital they are: '*Preparing projects for students to carry out takes time and although the projects are important they are not normally a priority*'. This may not necessarily be an indicator that the students cannot be trusted with heavy responsibility, but that, presumably, if the tasks in question were absolutely necessary, then the organisation would have paid a member of staff (or long established trained volunteer(s)) to do them.

The time-limited nature of the module can place pressure on students and staff. The taught programme takes place between late September and December. Students are taught some of the skills they need to find a placement—such as writing CVs and covering letters, and interview skills—during this time. At the same time, staff liaise with organisations in order to provide placement opportunities for students to apply to. This process starts in mid to late October, and goes on until all students are placed. Students are ideally expected to find a placement and be ready to begin it by January, when semester two starts and one day per week is timetabled for students to go out on placement. Alternatively, they can arrange to carry out a two week block placement in the Christmas or Easter holidays. In practice it can take some

students longer than this to find a placement, particularly for, on the one hand, students who have high expectations and are holding out for the 'perfect placement', or on the other, those who do not engage fully with the placement applications process. Students have the additional pressure during semester two of completing and submitting their final year undergraduate dissertation, at the same time as completing their placement. There is also little leeway for placement to overrun because this is the students' final year, and any delays in submitting work may jeopardise their chance of graduating with their class/cohort.

The timing of the placement can also limit the type of work students can do. With many students interested in taking part in ecological survey work, a representative of one such organisation commented: '*I think the timing of the placement can be a bit of an obstacle, as the most interesting aspects of our work occur during the summer time and the student would gain a lot more from attending at this time*'.

In some cases there may be a risk attached to sending students out on placement, especially if there are any doubts as to their behaviour or general approach to the placement. This can be a problem with students who do not initially engage with the placements process and who have to be found a placement at the last minute as a result. In such cases, placing an already reluctant student in a role they may not be very interested in can lead to negative results, with students turning up late, having an unhelpful attitude, or failing to attend for the full placement. Such behaviour from students gives a bad impression of the University, and can be even more frustrating because employers often offer such last-minute placements as a favour to staff, and such a result can potentially damage University-employer relationships.

The range of placements offered on the module is by necessity wide-ranging, because of the nature of the Department and the range of careers Geography and Environment students may enter. On an annual basis, the profile of students on the module can change markedly. For instance, in the 2013–2014 cohort, 15 students applied for a placement with a major utility provider; the following year, a similar placement in the same organisation attracted only one applicant. Differences in student interests and needs cannot always be easily matched in terms of providing new placement opportunities, as contacts with new organisations can take time to develop, and 'gaps' in provision do not always emerge until late in semester one.

Finally, while it is often desirable to provide a placement in which the student is fully responsible for their own project or activity, this does not mean that any other type of placement is not equally valuable. Depending on the organisation's needs and the interests of the individual student, other routes may be more appropriate, such as shadowing a staff member, splitting the time across different departments, or just getting stuck in and working alongside the team. The following comment illustrates this point:

> In our role it is almost impossible to take a project-based approach to the work placement. In this instance we decided to completely abandon it and just give the students as much hands-on experience as possible. This was largely due to our work. However, we also lacked the time to plan the placement adequately due to late take-up of the scheme and current organisational change.

On the odd occasion, a student has been proactive in the second year and completed a longer placement in the summer before the final year (e.g. on ERASMUS work placement abroad over 3 months), and then retrospectively completed the rest of this module process and assessment for credit, though this is very unusual.

The new HEAR (Higher Education Achievement Record) will make all such credits and additional activities and achievements, including volunteering facilitated through the University, transparent and evident for future employers.

7 Conclusions

There are still clearly ongoing issues to reflect on and consider.

This includes the delivery mode, where staff responsible should always look at ways to vary this (partly to suit different students' learning styles and strengths) and to provide interest. There is an ongoing need to combine activity with outcomes in changing work and industry contexts (for instance, around health and safety and public health responsibilities).

Every effort needs to be made to ensure that both employability (and lifelong learning for careers development and flexibility) and sustainability in the holistic sense make sense to students from the start of the module—and indeed the degree programme, which is why the Department is undertaking another such audit and strategic plan development currently, after previous such efforts over the past decade(s). Teaching methods likewise, in conjunction with University Careers staff and coaching at the work placement, need to be monitored and kept fresh and interactive and supportive, but also challenging and stretching.

For many students it is clear from the module evaluation and discussion with their departmental tutors—including for months afterwards and up to several years as Alumni—that they do not know what they have gained until the end of the module (and sometimes the degree programme) or even after they leave University. It is quite a common occurrence over the years that there are negative evaluations by students throughout the module (semester one, typically, before securing and going on a placement, often alongside poor attendance), but when students start applying for work it all makes sense finally, and this is reflected in part by positive module evaluations at the end of the module or well after the formal module evaluation is concluded.

There is an ongoing debate amongst staff on whether this module would be better, more effective or at least transformative in the second year of undergraduate degree study rather than their final year when they may be too busy. Also, with the current move in the University/Faculty and Department towards allowing and encouraging students to undertake year-long placements (or several placements amounting to that duration in sequence) should this module perhaps be moved to the second year of study so that year-long placements students can benefit from this (as good practice from Northumbria's Business School seems to suggest)?

A final questions concerns where the year long, and 10 day (flexible) work placements fit together, as well as (3–4 month) ERASMUS work placements, and indeed other volunteering placements facilitated through the University and a range of other agencies and companies during the year and especially in the summer months (especially between the second and third year), by the likes of Camp America or Operation Wallacea and others who frequently attract our Geography and Environment students.

It is clear that if Universities are at least in part to be financially supported by the state and by the communities/society which hosts them in various ways, including employers, they should be civically minded to develop capacity building for sustainable development in local (and national and international) communities through these partnership models, of which work placements for students where there is a net benefit for the host organisations/communities is a part (Shiel et al. 2015).

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Peter Glaves B.Sc. (Hons.), PGCE, Ph.D., is Director and External Engagement Enterprise Fellow and Principal Lecturer in Environmental Management and a chartered Ecologist and Environmental Manager. Prior to joining Northumbria University in 2010 Peter worked as a Principal Environmental Consultant and was Deputy Director of the Biodiversity and Landscape History Research Institute. He has nearly 25 years of lecturing in ecology and environmental management at a variety of UK universities, has been a programme leader for both undergraduate and postgraduate programmes, and has also been an external examiner for degree programmes and doctoral thesis. Peter has designed and led training courses in sustainable development and environmental assessment techniques in Britain and internationally. He has also been a facilitator and coach and regularly runs specialist training courses on environment economics, conflict management, environmental impact assessment, applied ecology and environmental management. Peter is an Editorial board member for four journals, He is a Member of the Institute for Ecology and Environmental Management (IEEM), and a Committee Member of IEEM's Training and Education Committee and Chair of Accreditation Review, and also a member of EUOPARC and the UK Environmental Law Association.

Richard Kotter Dip. Biol., M.A., PGCertRM is a Senior Lecturer in Economic and Political Geography, with an educational background in life sciences and environmental sciences and human geography and development studies at Tübingen University (Germany) and Sussex University (UK), and is a product of the ERASMUS scheme. and has benefited from a range of postgraduate EU academic training programme across Europe also. Richard researches into environmental and societal transformations, and urban and spatial change and planning in particular, with an interest in the socio-technical issues, but also community engagement. He reviews for a range of academic journals in geography and environmental sciences, and serves nationally on the UK's Geographical Association post-16 to HE committee, and moderates Access to Higher Education also for different providers. He is the current Programme Leader at Northumbria of the MSC in Disaster Management and Sustainable Development, with ties in with his own record of international humanitarian volunteering and (inter)national human rights campaign and coordination roles in a voluntary capacity.

Justine Wilkinson B.Sc. (Hons.), MPH, PGCE, is a Senior Lecturer in Environmental Health/Health Studies, and is a Chartered Environmental Health Practitioner with a local authority in the North East of England, with particular expertise in Public Health, Health and Safety and Food Safety and Standards. She qualified as an EHO in 1995 and has worked in local government in a range of roles including regulatory, educative, managerial and strategic. As a local government EHO Justine has responsibility for maintaining high standards of safety and health in businesses and safe production, handling and sale of food in food businesses. Justine completed her Masters in Public Health in 2007 and has worked on public health priorities at local, regional and national level with a particular focus on applying public health theory into practice. This work includes tobacco control, obesity, alcohol, accident prevention and management of a community health programme. She is a Fellow of the Higher Education Academy. Her research is related to raising the profile of Environmental Health and the role that local government plays in influencing public health, including the wider determinants of health.

The Role of Education for Sustainable Development in Maltese Marine Protected Areas: A Qualitative Study

Mark C. Mifsud and Marielle Verret

Abstract

The marine environment plays a crucial role in sustaining life on Earth as well as supporting human well-being. An array of ecosystem services are obtained from the marine environment and efforts have been taken to safeguard these invaluable services, namely through the institution of Marine Protected Areas (MPAs). The success of MPAs depends heavily on social factors, and therefore Education for Sustainable Development (ESD) can play a vital role in supporting MPAs by fostering related environmental knowledge, attitudes and values among local communities. This study explored the perceptions of key stakeholders in Malta with regards to the current state of play surrounding MPAs and ESD as well as its future direction. The research methodology had qualitative underpinnings and included 12 extended semi-structured interviews with key stakeholders. The study found that there is a lack of ESD addressing the marine environment in Malta but that stakeholders perceive ESD as being of critical importance in achieving effective MPAs. The research indicates that cooperation between stakeholders is the preferred approach to managing the MPAs. Based on the research findings, it is recommended that ESD surrounding the marine environment be further promoted within Malta through various means in order to promote MPA success and increase the engagement of local communities in marine conservation efforts. A contextualized Education

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Centered Management (ECM) model that illustrates the various connections and influences that lead to an effective MPA is proposed.

Keywords
Marine protected areas · Education for sustainable development · Qualitative framework · Stakeholder perceptions · MPA management

1 Introduction

The oceans cover about 70 % of our planet (Bollmann et al. 2010) and marine ecosystem services play a vital role in sustaining human wellbeing (UNEP 2006). However, it is clear that anthropogenic activity has severely altered marine biodiversity impeding its ability to provide these marine ecosystem services (Worm et al. 2006). In addressing the loss of marine biodiversity, spatial tools such as MPAs have been used increasingly throughout the world and MPAs are now generally regarded as an essential tool for marine conservation (Cullis-Suzuki and Pauly 2010).

Acknowledging the interconnectedness that exists between the world's population and oceans (Behnam 2013), there is evidence that social factors determine an MPA's success (Leisher et al. 2012). The International Union for the Conservation of Nature (IUCN) Guidelines for MPAs emphasize the need to gain the public's support through education and to generate a sense of ownership, which along with community involvement should serve as the main management tools (Kelleher 1999). The guidelines also suggest that educational efforts are important as they can result in the reduction of MPA enforcement costs (Kelleher 1999). Regarding the Cairns section of the Great Barrier Marine Park, Marine Park, Alder (1996) found that education programs were less expensive than enforcement, and also resulted in a wider community impact. Furthermore, a study by Thomassin et al. (2010) on Reunion Island stated that if local communities are accepting of an MPA, then the MPA managers can focus more on conservation activities instead of those related to enforcement.

The Mediterranean Sea is an important site for conservation as it is a hotspot for marine biodiversity (e.g. Coll et al. 2010; Mangos and Claudot 2013), and is characterized by high rates of endemism as well as habitat diversity (e.g. Abdulla et al. 2009; Coll et al. 2010; Portman et al. 2013). However, emerging threats such as overfishing, habitat loss, pollution, invasive species, climate change, as well as their interaction, are resulting in the loss of marine biodiversity in the Mediterranean (e.g. Coll et al. 2010; Lejeusne et al. 2010). A study undertaken by Coll et al. (2012) looked at areas of concern for marine biodiversity in the Mediterranean Sea and compared them to the locations of existing MPAs. The authors found that no more than 2 % of the Mediterranean's areas of concern for marine biodiversity are currently protected under an MPA, indicating a lack of representative coverage for existing MPAs in the same basin.

1.1 Marine ESD and Higher Education

The integration of sustainable development within higher-education institutions has increased in these last years. Such efforts include highlighting sustainability as a key theme within teaching, learning and research policies; increasing course content addressing sustainability; promoting initiatives encouraging sustainable energy and waste practices among students and teachers Nonetheless, evidence of efforts to include sustainable development related to the marine environment within European universities appears to be limited. These efforts include processes such as those by Chalmers University of Technology in Sweden that included "Marine and Maritime" as one of five knowledge clusters in a strategy implemented to achieve change for sustainable development (Holmberg et al. 2012), and the Nautical Faculty of Barcelona at the Universitat Politècnica de Catalunya that integrated sustainable development within all curricula (Castells et al. 2011).

2 Background to the Study

With regard to the local situation, the Maltese islands have a landmass of 316 km^2 (Government of Malta 2002) in total and a population of about 421,364 (National Statistics Office 2013). Therefore, Malta is densely populated and as it is an island with a large coastline when compared to its area, the marine environment is a central component of the local environment.

2.1 Marine ESD in Malta

In Malta, the ESD movement began in the 1960s and was lead by various NGOs (Pace 2002; Mifsud 2010). However, several challenges have undermined the prosperity of EE among the Maltese islands, namely: the competitive educational system; the non-committal policy of the Maltese government; and the prevalent colonial mentality (Mifsud 2010). Regarding the colonial mentality's influence, Mayo et al. (2008) state that it has led people to narrow their view to that of 'my home' as opposed to 'my environment'. Pace (1997) and Mifsud (2012) have both pointed to the need for increased involvement of the Maltese public within decision-making processes.

In 2007, the 32nd Pacem in Maribus conference was held in Malta to commemorate the 40th anniversary of Arvid Pardo's speech to the United Nations regarding the oceans as the Common Heritage of Mankind. The conference's outcome document, the Malta Declaration, called for intensified education efforts surrounding sustainable ocean governance, especially for women and youth. In examining Malta's National Curriculum Framework (NCF) (2012), Education for Sustainable Development (ESD) features as one of the learning areas for junior and secondary students. Though there is no explicit reference to the marine

environment, the learning area's description states that the learner's environment should be "locally relevant and culturally sensitive" (MEDE 2012, p. 56).

Pace (2002) discussed the situation regarding ESD surrounding marine resources in Malta. The author identified important lacunas, including the lack of marine educational experiences for children. In addition, Pace (2002, p. 4) stated that although ESD does feature within Maltese schools, "very little attention is given to the local marine environment". Despite this lacuna, the author did acknowledge the existence of post secondary programs related to the marine aspect. Interestingly, Pace (2002) suggests that the lack of inclusion of Malta's marine environment within ESD can be attributed to the country's reliance on British teaching materials. Again, influences from the colonial mentality appear to still be in existence today.

2.2 MPAs in Malta

Mangos et al. (2010) found that Malta benefits from the Mediterranean's marine ecosystems at a value of 83 million Euros per year. Currently in Malta, there are five designated MPAs: Grigal ta' Malta, Filfla, Rdum Majjiesa, Mgarr ix-Xini and Dwejra, collectively extending over an estimated 180 km^2, or 5 % of Malta's territorial waters (Fig. 1).

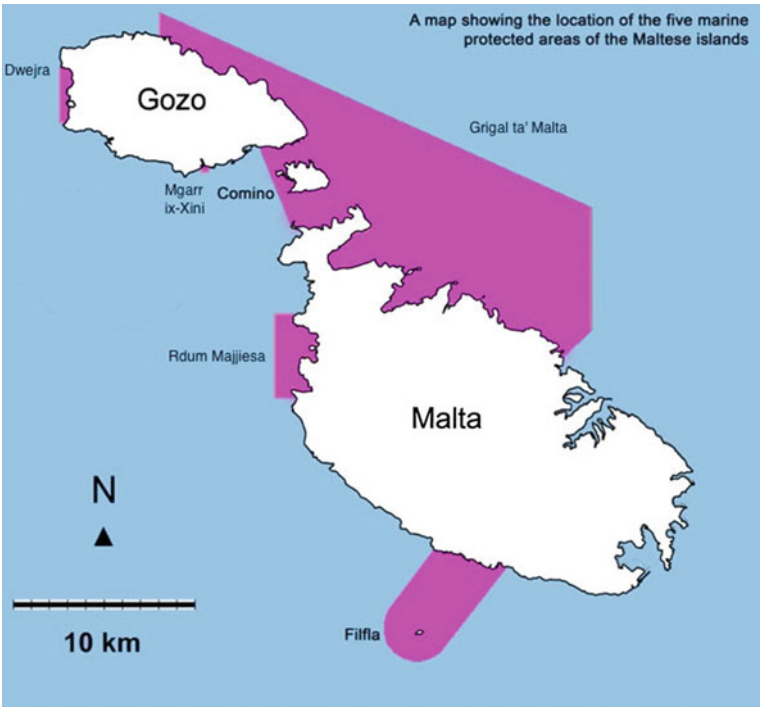

Fig. 1 Map depicting the location of Malta's 5 MPAs

Although management plans have already been drafted or are currently being drafted for all five Maltese MPAs, none have been implemented yet (Verret 2014). In examining the already drafted management and action plans for Malta's MPAs, some provisions have been made for education. However, Deidun (2011, p. 8) states that there has been a "complete lack" of EE initiatives associated with Malta's MPAs. In Malta, the designated MPAs have been designed to represent 80 % of Malta's *Posidonia oceanica* meadows (MEPA 2010). This seagrass species is endemic to the Mediterranean and is particularly important in supporting marine biodiversity since it is an ecosystem engineer (e.g. Michel et al. 2011; Personnic et al. 2014). Among its functions, the seagrass meadows provide important fish habitat (Kalogirou et al. 2010), promote water quality and act as a carbon sink (Pergent et al. 2012).

3 Methods

This study adopted the mixed-methods approach as the research methodology, combining the collection of both quantitative and qualitative data. A questionnaire targeting the Maltese public was developed to collect quantitative data, while semi-structured interviews were carried out with key stakeholders for the qualitative data collection. For the purposes of this paper, only the qualitative portion of the research will be considered. The stakeholders to be interviewed were identified based on a literature review of ESD in Malta and by a review of the existing management and action plans for Malta's MPAs. These include an action plan for Dwerja as well as management plans for Filfla and Rdum Majjiesa (Verret 2014). The literature review of ESD in Malta allowed for the identification of key stakeholders involved in the delivery and management of ESD initiatives on the island (Fig. 2).

The semi-structured interviews were conducted face-to-face and included thirteen questions. In total, twelve interviews were undertaken and included within the study. Two of the twelve stakeholders interviewed submitted their responses via e-mail since they were unable to meet in person. The interview questions were developed to address four main themes:

- Marine Education for Sustainable Development
- Marine Protected Areas in Malta
- Stakeholder Involvement in the Management of MPAs
- Implementation of Malta's MPAs

The verbatim transcriptions were subsequently analyzed in two phases: an individual question analysis followed by an overall thematic analysis. The first phase of analysis allowed comparisons to be made between the answers from different stakeholders to each individual question, identifying patterns based on key words. The overall thematic analysis was conducted afterwards and entailed coding the responses from the different stakeholders under umbrellas of different themes. This process included responses across all questions, as opposed to being limited to the individual question. Employing both analyses ensured that the main findings

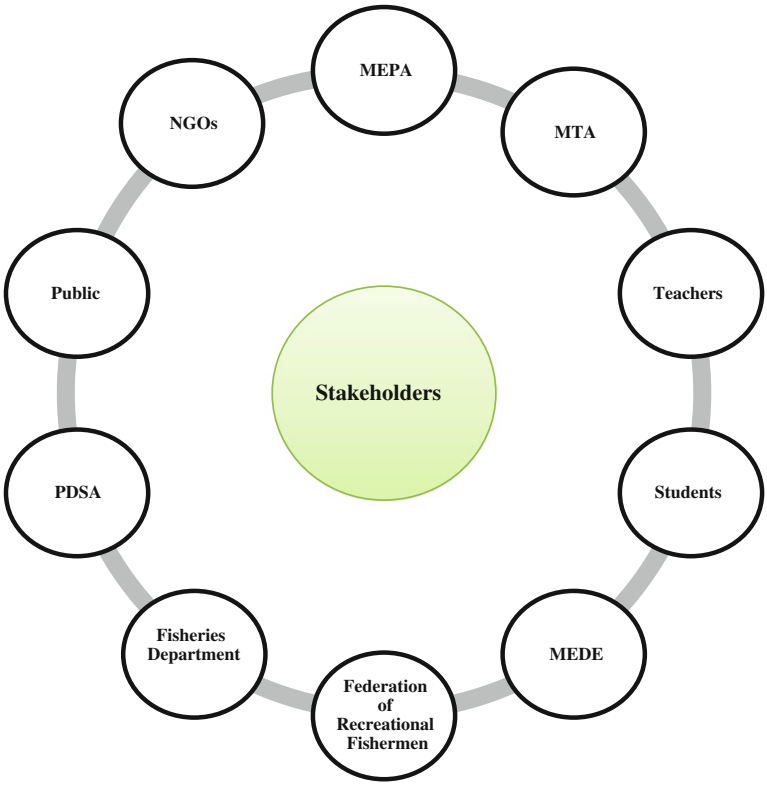

Fig. 2 Stakeholders selected for the interviews

from the transcriptions were identified without excluding segments of data. The observations selected for inclusion within the context of this paper represent those that demonstrate the strongest identified themes across all interviewed stakeholders. The observations are presented under three overarching findings and are preceded by a short description speaking to the specific quotations.

The undertaken research included a number of limitations. First of all, the authors hoped to include an interview with an economic operator from Gozo to further represent this island within the study, however it was not possible to contact an appropriate representative within the allocated timeframe. Secondly, the interviews were conducted in English due to the researcher being a non-Maltese speaker, limiting the expression of stakeholders to English only. Lastly, this study represents a qualitative baseline study on the topic of ESD and MPAs in Malta, therefore stakeholders were encouraged to discuss issues in a general manner as opposed to being prompted to discuss specific issues in a more detailed fashion. The authors were conscious of these limitations from the beginning of the study and therefore the interview procedures and the wording used were continuously analysed in order to minimise these limitations as much as possible.

4 The Findings

This is the only study employing interviews to investigate specifically the relationship between ESD and MPAs in Malta. All stakeholders were asked the same set of questions and a variety of views surfaced surrounding different issues related to marine ESD and MPAs in Malta.

4.1 The Need for Marine ESD

Stakeholders pointed to a lack of ESD surrounding the marine environment in Malta and suggested that more attention is currently being paid to the terrestrial environment:

> …come to think of it, land protected areas, yes we do hear about Natura 2000 sties, but when it comes to marine ecosystems we're not really exposed to that information. [Science Teacher].

> Environmental Education and Malta's marine environment, it started but what we have been consolidating so far is Environmental Education that is more related to land issues. [Nature Trust Malta].

> Perhaps in current education, environmental education programs, it [marine environment] is not a highlight. [Ministry for Education and Employment].

Stakeholders made it clear that though marine ESD in Malta is lacking, they perceive it as highly important:

> …proper marine education, since we are a nation surrounded by sea, should be at the top of our bloody list. [Professional Diving School Association].

> I think it [link between EE and marine conservation] needs to be strengthened. But given that Malta is an island, it is of great importance. [Ministry for Education and Employment].

> to seek to conserve and establish measures without either educating in parallel or without having an educated audience, the conservation would likely to be a failure. [Malta Environment & Planning Authority].

Though interviewees identified the lack of marine ESD in Malta, they recognized the potential benefits associated with it. The interviewees appeared to believe that marine ESD could lead to increased appreciation and in turn, conservation of Malta's marine environment:

> Education can help people love the environment and eventually they will care for it more. [Malta Tourism Authority].

> …if we educate students about the marine environment, about the environment in general, land or marine, they're obviously the future generation which are going to care for the environment, which are going to conserve the environment. [Science Teacher].

> So yes I do believe that education, it starts from early years education to create appreciation. Because once it is almost instilled in you, at a young age, then it becomes something automatic to safeguard the marine environment and the terrestrial environment. [Undergraduate Student from the University of Malta].

The fact that ESD can support marine conservation efforts seems to be understood among stakeholders but they also recognize the need for it to be reinforced in order to for there to be benefits to Malta's population and marine environment.

4.2 The Relationship Between MPA Enforcement and ESD

The issue of enforcement also came to light during the interviewees' responses. Stakeholders appeared to appreciate the importance of enforcement surrounding Malta's MPAs but also identified the existing lack of it:

> There's a vague idea of what they have in mind but there's no management and no enforcement. On any of the 5 MPAs in Malta. [Federation of Recreational Fishermen].

> I know that there are 5 MPAs in Malta and I recently discovered that they are 5 Natura 2000s and they are part of the Natura 2000 network. However, there are no conservation measures yet so basically for now they are just on paper. [Fisheries Department].

> No regulations, nobody enforcing, I mean why create it in the first place. [Professional Diving School Association].

Furthermore, the link between enforcement and education was highlighted. The interviewees made it clear that they value both education and enforcement, and it would be ineffective to address one without addressing the other.

> I also believe that if regulations were introduced, then that would give the protection of the MPA a good push start and the education can compliment this. There would also need to be enforcement which is an area that Malta lacks. [Nature Trust].

> …we need to get enforcement going in some way. You need to get an educational campaign going at the same time because you cannot enforce without education, they go hand in hand. [Professional Diving School Association].

With regards to reasons for the lack of implementation and enforcement of Malta's MPAs, stakeholders identified the lack of political support and resources as the main reasons:

> I mean, because if you create a certain awareness, then the politician has to take some sort of action about it. [Interview with a postgraduate student from the University of Malta].

> Resources, this is important resources. [Malta Environment and Planning Authority].

> So these are so intensive as a project, of such a large magnitude that you need the resources, the human resources, the financial resources, to implement, to start doing these collection of data for example. [Interview with an ESD representative from Nature Trust].

4.3 Collaborative Approach to Management of Malta's MPAs

All respondents identified that stakeholders should work cooperatively in the management of Malta's MPAs, suggesting that this would heighten their success:

> …when entities or representatives from different entities are working independently, from various experiences, I think there is a lot of fragmentation of the concept and overlapping. And in that way, there is needless energy, human resources, they're not being used effectively. While if cooperatively I think we manage the issue or the situation better. [Ministry for Education and Employment].

> It's cooperation that gives results otherwise there will always be stakeholders that loggerheads with each other. [Nature Trust Malta].

> If you don't involve all stakeholders and if you go and impose a ready- made policy onto stakeholders, I think that would be a recipe for disaster. [Postgraduate Student from the University of Malta].

Additionally, practical ways to promote stakeholder involvement were suggested by multiple stakeholders:

> …I think that they should be involved as much within a central committee there should be a body for example a committee that is consulted on a regular basis and then the committee takes decisions, may not necessarily involve the stakeholders but consultation and the serious consideration of this and the outcome of such consultation is considered. [Malta's Environment and Planning Authority].

> But as I said, like it needs to be genuine individuals or organizations coming together. So, it could be like a board or something, specifically to take care of this kind of issue. [Member of the Public].

> However, sometimes you need to see which stakeholders you have and maybe also do meetings individually. [Fisheries Department].

Stakeholders did identify some existing conflicts between the various organizations and so establishing a cooperative approach to management could aid in bridging these conflicts:

> We do have some conflicts with the commercial fishermen and we do also have conflicts with the diving society. [Interview with a representative from the Federation of Recreational Fishermen].

> I think there is quite a conflict of interest from all stakeholders. As in everything else. [Interview with an undergraduate student from the University of Malta].

The Malta Environment & Planning Authority (MEPA) is entrusted with the authority to designate, manage and enforce Malta's MPAs. Stakeholders appeared aware that MEPA is the authority responsible for the designation and management of MPAs. However, some interviewees suggested a lack of trust in the organization, questioning its ability to effectively manage Malta's MPAs:

> MEPA, when it comes to other issues, I don't really trust… Because MEPA is quite bureaucratic and there's a lot of, some people, in my opinion they're a bit of mafias… [Member of the Public].

> So they are not there at this stage, they said that at an eventual stage they will do something but I'm sure that they [MEPA] won't do anything. [Professional Diving School Association].

5 Discussion

As demonstrated by the findings, stakeholders in Malta recognize the lack of ESD surrounding the marine environment, validating what was found during the literature review (i.e. Pace 2002). Though stakeholders strongly value marine ESD, they also highlighted the need to address issues of implementation and enforcement surrounding the local MPAs. Since collaboration was identified as the preferred approach to managing Malta's MPAs, it is hoped that stakeholders can work together towards promoting marine ESD as part of their activities. A set of eight recommendations (see Box 1) to strengthen the relationship between ESD and MPAs in Malta is offered based on analysis of literature and the findings of this study. These recommendations were constructed to address existing gaps and build on identified opportunities in order to foster a sense of ownership among the Maltese public by encouraging their involvement in MPA management. It is proposed that the actions embedded within the recommendations be undertaken by a host of relevant stakeholders in Malta, including the Malta Planning and Environment Authority (MEPA); local schools; the Centre for Environmental Education and Research (CEER); the Ministry for Education and Employment (MEDE); local communities as well as other stakeholders.

In terms of areas for future research, it would be interesting to conduct similar interviews with stakeholders once an or all MPAs in Malta are implemented. The findings of such a study could shed light on the effectiveness of implemented MPA management mechanisms and assess whether marine ESD is being sufficiently integrated within Malta. As one of the first studies examining specifically marine ESD in Malta, it is essential that further research be conducted to evaluate the country's progress as it related to this field and to provide updated recommendations for positive change. For an island state like Malta, marine ESD could provide many benefits to both the country's human population and marine resources, heightening its sustainability as we move into the future.

Box 1: Recommendations to strengthen relationship between ESD and MPAs in Malta

Recommendations to strengthen relationship between ESD and MPA's:

1. Expand the scope of current ESD programs in Malta to include the marine environment, a central component of the local environment. This process is expected to be more efficient than creating new ESD programs targeting specifically the marine environment.

2. Establish a mechanism allowing stakeholders to work cooperatively towards the management of Malta's MPAs since cooperation was identified as the preferred management approach during the interviews.
3. Address issues of implementation and enforcement surrounding Malta's MPAs. Stakeholders emphasized the need to establish MPA rules and regulations before being able to seriously discuss associated ESD initiatives.
4. Create partnerships between different entities in Malta to promote and deliver ESD related to MPAs. The combined levels of knowledge, experience and resources from a variety of organizations could facilitate the delivery of ESD programs.
5. Increase collaboration between the University of Malta and MPA managers to meet data collection requirements for the MPAs. Students could participate in data collection for baseline studies and monitoring, which could present financial as well as educational benefits.
6. Promote information about Malta's marine environment to the public using media platforms, such as local television networks.
7. Explicitly include the marine environment under the National Curriculum Framework (NCF)'s ESD learning area. Currently, the NCF contains ESD as a learning area for junior and secondary students but does not mention the marine environment.
8. Utilise Malta's identity and heritage as an island nation as a basis for marine ESD. This could foster an increased sense of ownership and responsibility towards the marine environment among the Maltese public.

6 Conclusion

To conclude, this study found that key stakeholders in Malta recognize the need for increased ESD efforts related to the marine environment; that enforcement and education surrounding MPAs cannot exist in silo from one another; and that a collaborative approach to the management of MPAs is preferred. This baseline study identified essential issues that need to be addressed in order to improve the relationship between ESD and MPAs in Malta. The qualitative methodology employed to uncover these findings may be applied in other countries following careful contextualization. Identification of local key stakeholders in other countries may help build a regional database that may be helpful to governance networks and delivery mechanisms related to education and marine conservation. Further research should be conducted to enhance the identified observations through comparative studies and assess changes that unfold in future scenarios.

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Educational Landscapes for Sustainable Development in Cities. Actors, Structures and Processes in Osnabrück

Gerhard Becker

Abstract

"Educational Landscape of Sustainable Development (ELSD)" is a concept still quite new in Germany and recently being implied in Osnabrueck and in those other German cities that were awarded with the label "City of the UN-Decade Education for Sustainable Development". The complex subject will be dealt with under selected aspects at International and local level and illustrated by means of the example of Osnabrueck. The general role of towns or cities and regions within the process of Sustainable Development (SD) and Education for Sustainable Development (ESD) is the subject of Sect. 1. Section 2 offers a historic review on previous international concepts of education for a 'learning society' which led to the development of more recent concepts, similar to ELSD such as 'Learning Cities' and 'Sustainable Learning Cities and Regions' (SLCR) in some cities in Germany. Due to a lack of a general standard definition of SD, the author presents his more differentiated, six-dimensional conception, which includes education as one of these dimensions that corresponds in an ideal manner to the objectives of SLCR or ELSD (Sect. 3). On one hand, ELSD is being derived from the debates and practical approaches of ESD in Germany (Sect. 4) previously separated, and from educational landscapes on the other (Sect. 5). The current situation of ELSD under construction in Osnabrück is only comprehensible if it is considered from the background of its previous history of more than 30 years in which the Local Agenda 21 and respective organisations played a major role. Of special importance are also the numerous awards in the context of the Decade (DESD), which gave strong impetus for the further development of LESD in Osnabrück (Sects. 6–9).

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Education for sustainable development · Urban sustainability · Educational landscape · Local agenda 21 · Sustainable learning cities · Sustainable city · Sustainability

1 The Role of Cities and Communities for ESD—International

At the United Nations Conference on Environment and Development (UNCED) in 1992 in Rio de Janeiro ('Earth Summit'), the 178 participating states concluded, amongst others, the '*Rio Declaration on Environment and Development*' (27 principles) and the *Agenda 21*, which represents an extensive programme of action for sustainable development in the 21st century worldwide. In its 40 chapters on 360 pages, recommendations and possible forms of solutions for the most urgent questions are suggested in detailed manner. In Section III in Chapter 23–32 special focus is put on "Strengthening the role of major groups", i.e. participation, as a precondition for success and a democratic claim for SD. Chapter 28 stresses in particular the importance of strengthening the role of the communities "*Because so many of the problems and solutions being addressed by Agenda 21 have their roots in local activities, the participation and cooperation of local authorities will be a determining factor in fulfilling its objectives. Local authorities construct, operate and maintain economic, social and environmental infrastructure, oversee planning processes, establish local environmental policies and regulations, and assist in implementing national and subnational environmental policies. As the level of governance closest to the people, they play a vital role in educating, mobilizing and responding to the public to promote sustainable development*".

Chapter 36 (Promoting Education, Public Awareness and Training), that follows chapter 35 (Science for Sustainable Development) in section IV of the Agenda 21, is the centre piece and historical point of departure for ESD worldwide. It was Chapter 28 which started off many processes of a 'Local Agenda 21' (LA 21) that are being organized for more than 20 years now in cooperation with the citizens and organisations of civil society and private industry in many thousands of cities and towns and numerous countries (amongst others also in Osnabrück). This process was partly organised and supported by the 'International City Network (ICLEI). This local approach for SD and ESD under the popular slogan "*Think globally—act locally!*" was reflected by several conferences, programmes, declarations and resolutions at National and International level, e.g. the European Cities and Towns Towards Sustainability (Aalborg-Charta 1994), in which also German towns took part (http://www.sustainablecities.eu). During the past twenty years, several new networks of towns and cities developed at International level, most of them dedicated to a special thematic focus within SD: "Climate Alliance of European Cities with Indigenous Rainforest Peoples" (since 1990), "Fair Trade Towns" (with 2200

cities from 25 countries), Energy Cities, Healthy Cities, Green Cities etc. A characteristic feature of many of these networks—at least in Western countries—is a strong participation of citizens' groups and initiatives. In these cities and regions ESD, was not so much important as a defined term and systematic approach, but rather dealt with processes of informal learning and public awareness in particular relation to ESD.

With the recommendation of the UN Conference on Sustainable Development (UNCSD), also known as Rio+20 in 2012, it was stipulated in the same year by the UN to have the Decade of Education for Sustainable Development (DESD) last from 2005 to 2014 and to be organized by UNESCO (http://www.desd.org/). With this major global impetus, the conceptual development of ESD and above all adequate guidelines for practical action were significantly promoted in many countries. It became clearly evident that in particular for ESD the local and regional level are of utmost importance: It is here where many actors (organisations, institutions, citizens who feel committed) can do efficient work in close cooperation with the citizens and in particular in view of the benefit of children/adolescents. This idea was then implemented and further developed in many cities, towns and countries.

At many political events and in many decisions, the utmost importance of ESD for all fields of education and for all subjects of sustainable development was unanimously stressed (including vocational training, non-formal education, informal learning and public awareness). Nevertheless and despite the fact that many highly successful projects were carried out, a systematic implementation into practice is still lacking today in many fields of education and areas of community work. This is why the implementation of the strategic imperative "From project to structure" (DUK 2014a, b) will be the next decisive step for the future of ESD and SD.

In the meantime, the 'Global Action Programme' ESD (GAP) worldwide has been concluded for a period of five or perhaps ten years from 2015 onwards. In the "*Roadmap for Implementing the Global Action Programme on ESD*" the local level of action was emphasised as one of the five "*priority action areas*": "*Accelerating sustainable solutions at local level: At community level, scale up ESD programmes and multi-stakeholder ESD networks*". In an increasing manner, ESD and the local/regional level gains in importance also in other International areas of the UN and its organisations (see e.g. https://www.worldwewant2015.org):

- During the above mentioned UN-Conference Rio+20 of 2012, it was decided to enhance the Millennium Development Goals (MDG) from the year 2000 to Sustainable Development Goals (SDG) and in 2012 the UN General Assembly resolved on the 50 page document "The Future We Want" which continues in line of the Agenda 21 to: "*renew our commitment to sustainable development and to ensuring the promotion of an economically, socially and environmentally sustainable future for our planet and for present and future generations*". In all subject areas of SD, ESD is (again) attributed major and reinforced significance (see in particular, articles 229–235).

- A concept paper on the SDGs has been presented which is to be concluded in September 2015 by the General Assembly of the UN and so far evoked many intensive discussions. It contains 17 articles, article 4 on education reads as follows; "*Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all*". In sub article 4.7., it carries on; "*by 2030 ensure all learners acquire knowledge and skills needed to promote sustainable development, including among others through ESD 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.*"
- Whilst the Programme *Education for all* (EFA) that emerged from the last *World Education Forum* in Dakar in the year 2000 strongly focussed on educational access in less developed countries, the new initiative *Education 2030* is addressed to the entire humanity with its declared objective *Towards inclusive and equitable quality education and lifelong learning for all*. At the end of the World Educational Forum of the UNESCO in May 2015 (Incheon, South-Korea), a declaration on global education policies was adopted: Its new vision directly refers to the (educational) goals of the future SDGs and of the GAP on ESD: "*we strongly support the implementation of the Global Action Programme on ESD launched at the UNESCO World Conference on ESD in Aichi-Nagoya in 2014. We also stress the importance of human rights education and training in order to achieve the post-2015 sustainable development agenda*" (*UNESCO* 2015).

In summary: The fact that several strings of UN policies with different subject-orientations are combined to a joint perspective of SD may be regarded as a positive form of development. These include climate policy as well as the relevant UN Conference *Framework Convention on Climate Change* in December 2015 in Paris.

2 The Treasure Within Learning—Learning Cities—Sustainable Learning Cities and Regions

The fact that cities and communities play a vital role for the development of education and learning in general was recognized and discussed already long before the Agenda 21 and found its expression in respective concepts. For example in the Report "Learning to Be: The World of Education Today and Tomorrow"—also promoted by the ideas of famous educators like P. Freire (Watson 2015, p. 6), J. Dewey, …: "Local and national communities are in themselves eminently educative institutions" (Faure et al. 1972, p. 162). 24 years later a second Report of UNESCO "Learning: The Treasure within" (Delors et al. 1996) was published with a different socio-political contexts (crisis of education/social movement—End of the socialist model/End of the Cold War/Neoliberalism) but these both reports have many similarities (Elfert 2015, S. 89ff). The ideal vision of education had a political

dimension in terms of the emancipatory claim for justice and equality. This vision is also a vision of a 'learning society', of lifelong learning and 'learning throughout life' (UNESCO 2002). In order to build a learning society and make lifelong learning a reality, it is important to embrace and connect all learning stages, types and places. This vision resembles more recent ideas of 'Educational Landscapes' for local communities and regions in Germany (Sect. 5). Whilst, on the one hand, the National politicians of most countries tried to push through the technocratic and utilitarian concepts of the OECD and the World Bank and implement these into educational practices; i.e. skills and competencies for labour market needs in the context of a competitive society, also positive movements continued to develop simultaneously (see Sect. 1), although SD and ESD did not play a major role in most discussions and investigations of the past 20 years.

Perhaps the initiative of UNESCO, 'Rethinking Education', will help to introduce considerable changes to this attitude by formulating the humanistic and universal vision of UNESCO on the future of education in the context of the current post-2015 debates (UNESCO ERF 2013; UNESCO 2014; Tawil and Cougoureux 2013, p. 8).

'Learning cities' is one significant approach of learning societies that was developed in recent years (also 'learning communities', and 'learning regions') (Roche 2015; Fitzgerald and Zientek 2015; UNESCO 2013b). This idea has been discussed and conceptualised in developed countries since the 1980s (OECD 2002), but with an economical background, because learning cities and regions are very important for knowledge and innovation based industries and also for developing countries (e.g. Osborne et al. 2013). Processes of 'Learning cities' are important tools for sustaining social, economic, ecological, cultural and democratic issues (Sect. 3) and vice versa. But in most Learning Cities local sustainable development has not made subject of discussion, yet. In the general introduction of a case study on the city Kaunda in Lithuania, Juceviciene wrote "*The sustainable development of a Learning City is based on a twofold approach: to help inhabitants, organisations and communities to solve relevant problems by empowering their learning processes and promoting respect for the principles of sustainability. Thus, the conditions for expanding the concept of the Learning City into the Learning Sustainable City are created*" (Juceviciene 2010, S. 434/35). Kearns (2012) holds a similar, highly ambitious view by promoting his approach of a healthy life style as a further, important goal.

Also, the importance of sustainability was stressed in an increasing manner at both, the International Conference on Learning Cities in Beijing (2013) and the International Conference on Learning Cities in Mexico (2015). "Promoting Sustainable Development" is pronounced as the third Commitment of the Beijing Declaration (UNESCO 2013a). In the 'Key features' of this conference a Learning City is defined as a city "which effectively mobilises its resources in every sector […] and will create and reinforce individual empowerment and social cohesion, economic and cultural prosperity, and sustainable development" (UNESCO 2013a).

This second Conference in Mexico "will mark a milestone towards 'Building Sustainable Learning Cities' and make a significant contribution to the achievement of UNESCO's 2030 education agenda" (see announcement at http://www.learningcities2015.org/).

All conclusions and programmes mentioned in Sects. 1 and 2 can only offer a general framework for practical implementation. Already many years before, much effort was made of developing precise methods for the successful promotion of sustainable development in cities and regions and for to estimating the respective effects in view of uncertainty, indeterminacy and multiplicity (e.g. Ravetz 2000). This task will become even more complicated if the wide field of Education and Learning (formal and non-formal) is included, which already is highly complicated on its own. In nearly all publications on SD, which in the meantime have grown to a vast number, the aspect of education is only marginally considered, if at all or only been regarded as a secondary tool for sustainability.

On the one hand, it is necessary to develop and try out concepts of a holistic regional approach for local/regional sustainable development and its implementation which are essentially characterized by inclusive forms of participation and education in all areas (see Sect. 3). This necessarily implies a certain democratic openness of processes. On the other hand: Within the context of increasing liberalisation, deregulation and privatization, cities that are often characterized as powerful actors of social development are more and more exposed to external constraints and parameters (e.g. Heinz 2015) quite incompatible with SD.

3 Sustainable Development (SD) as a Six-Dimensional Concept

The ultimate aim of SD is to improve the life conditions and needs of present and future generations (intergenerational and international justice). It is a widespread idea—also included in the *Agenda 21*—that this requires the integration of ecological, economical/environmental and social aspects at all local and global levels. In Germany this postulate is often called the '*Triangle of sustainability*' or '*three pillars of sustainability*', represented in a symbolic manner in several graphic illustrations and being frequently employed in all recent debates and conventions as an argumentative instrument. Mostly on basis of this three-dimensional postulate, further and more differentiated models were introduced into the academic and political debates of the last 20 years, all presented in numerous scientific publications. In some of them, also other dimensions of SD are included, such as culture, health etc. My own concept that forms the basis of the work of many organisations and projects in Osnabrück, distinguishes amongst six dimensions which all work in interaction. For more than 15 years, this model has been translated graphically as a six-pointed star of sustainable development and been disseminated in several publications (e.g. Becker 2001 ff) (Fig. 1).

Fig. 1 G. Becker six-pointed star of sustainable development

Economy means economic development, Ecology means environmental protection and Justice for me implies social justice (in graphics often too simply abbreviated as 'society'). In addition to these usual three dimensions, I also include '*Participation'* (of groups and citizens), '*Culture*' *and* '*Education*' as other independent dimensions.

Participation and education are indispensable for the Agenda 21 and the subsequent conception of SD, but unfortunately they are reduced and conceived only as instruments for the three dimensions. Their independent relevance for a successful SD is being ignored. In particular, they are highly significant when we look at the local aspects of a city or community, and they can be implemented more easily at local level (see Sect. 1). Furthermore, education in a broad interpretation and in all areas, also including the informal sector and publicity for measures of sustainable urban development (e.g. of public or communal institutions) is an indispensable precondition for successful and democratic participation. ESD can contribute substantially to develop sustainable cities and regions and teaches all citizens daily competences for organizing their lives. Nearly all over Germany one generally agrees that the major and general target of ESD consists of the so-called '*Gestaltungskompetenz*' *(*shaping competence) which refers to anticipating and autonomous participation in shaping sustainable development. However, there is fewer consensus when it comes to the question whether ESD can or should also include personality development in the sense of a humanistic concept of education (Jahrbuch BNE 2015, p. 148ff).

Occasionally, the cultural dimension is conceived as a fourth dimension. At least implicitly, this holds true for the UNESCO, which stresses the relation of Culture and Sustainable Development Strategies at the latest since the "Convention on the Protection and Promotion of the Diversity of Cultural Expressions" of UNESCO (2005) and the following programmes. In the academic field, this view has been shared for some time by some scientists of the Leuphana University in Lüneburg (e.g. Stoltenberg 2009). The cultural dimension, however, does not refer to conservation and consideration of cultural diversity alone. What SD requires is to radically change the modern non-sustainable culture of daily life (e.g. consumer-oriented style of life) in many economically developed countries; as well as to develop sustainable alternatives in numerous, less developed countries. This is why culture with its diverse concepts must be considered as an independent dimension for SD and ESD.

Consequently, these six dimensions should be employed as an ideal model and overall concept for an integrative analysis of subjects and problems of non-sustainability and—what is even more important—be considered in processes of integrative planning of SD. Finally, this six-dimensional conception opens up the view for a broader spectrum of potential actors (see Sects. 5–7).

For the organisation of ESD efforts, this differentiated model implies an orientation along the lines of the other five dimensions of SD. As a rule, such an integration of dimensions is not possible without any contradictions; in the end one will not be able to avoid political or personal processes of appreciation of values. This requires democratic discussions and a possibly broad participation of all persons concerned and involved, which is more easily to be achieved at local level. What is also necessary, however, is to combine this with public relation and environmental awareness training. ESD empowers citizens to shape their own lives as well as the future of their communities. This again is the "shaping competence" for our social and individual future. ESD is a 'real' and inalienable utopia (Becker 2008).

4 Local/Regional ESD in Germany

Under International comparison, the Decade of ESD (DESD) in Germany was quite successful: Whilst, on one hand, many initiatives took place within and outside of national, communal or other institutions, there was a lot of political support offered at Federal and regional level in form of numerous resolutions and programmes on the other (e.g. National Plan of ESD). With sponsorship by the Federal Ministry for Education and Research, the German Commission for *UNESCO* (*DUK*) took over the responsibility of being in charge for the German activities that were under the patronage of the German Federal President. The DUK convened a National Committee for organising the implementation of the Decade in Germany. A very efficient instrument for the growing success in Germany was the fact that awards were received on basis of the successful and exemplary work in the fields of ESD.

From 2005 to the end of 2014, about 2000 projects and/or organisations as well as many measures received an award, and since 2008 also 21 cities such as Hamburg, Frankfurt, Freiburg, München, Dresden, Bonn, Heidelberg, Gelsenkirchen, Erfurt and in 2013 also Osnabrück and some smaller communities were awarded ('Cities and local authorities of the DESD'). Although these awards were not combined with a financial prize, they implied a strong motivational gain for the actors as the awards increased the degree of popularity in public and often led to financial support, e.g. when applying for sponsorship with foundations, municipalities or other sponsoring bodies. This reinforced the work within ESD and the projects of the actors on site. It was largely due to this 'culture of awards' that the DESD was rather successful in Germany. This effective work was supported by the state. The same holds true for organizing and coordinating of several national working teams on significant fields of education and selected thematic areas, as well as the construction and maintenance of the two portals www.bne-portal.de and www.globaleslernen.de which include all important information, publications and awards.

All 21 cities and smaller communities that received an award work together in a National *Working Group* '*Communities and ESD*'. I personally learnt that the cooperation in this group and the exchange of ideas and experience implied proved to be very valuable for the work on site. In the meantime, an analytical study on networks has been elaborated which is highly informative and analyses the educational landscape of five selected cities and communities of different type and seize (Fischbach et al. 2015). Thanks to the successful strategies of this working group and the community approach implied, the local level of ESD was included into the International debates of the UNESCO and finally also into the final conference of the Decade in November 2014 in Japan. This was also reflected in the Roadmap for the GAP from 2015 onwards (see Sect. 1).

This German working group of communities continues their projects and processes under the frame of the GAP for ESD. At present (June 2015) it still remains unclear which substantial support will be granted from the respective local and national authorities in Germany.

5 About the Term "Educational Landscape" and Its Significance for ESD

With the 'Declaration of Aachen' (DST 2007) and the 'Declaration of Munich' (DST 2013) of the 'German Conference of Cities' the fairly new term 'Bildungslandschaften' ('Educational Landscape') already gained strong importance at the level of local policies in Germany. This was also reinforced by the federal-wide promotional project '*Lernen vor Ort*' (Learning on Site) which at regional level focussed mainly on "coherent educational management", "equal opportunities" and "social advancement by means of education". In pedagogical literature, the wide-spread term "educational landscape" (Bleckmann and Durdel 2009;

Bleckmann et al. 2012; DKJS 2010, 2014; Bollweg et al. 2011; Coelen et al. 2015; DVÖPF 2009; Heinrich-Böll-Stiftung 2011) is being used in most different manners in Germany, in its conceptual definition as well as in practice and with regards to its intended function, and sometimes even from a critical viewpoint (Mattern and Lindner 2015). The development tends to divert the attention from its original focus on local school systems and all-day schools to extend to more non-formal fields of education and publicity work on subjects with relevance for community policies. In addition, subjects such as informal education, learning in everyday life and in the public field are also being taken into consideration: "*local educational environments (landscapes), long-term networks on the subject of education with the aim of joint planned action and supported by community policies that start off from the perspective of the learning subject, include formal sites of education and informal worlds of learning and are related to a defined local space*" (Bleckmann and Durdel 2009, p. 12).

Controversial debates are held for instance between the following positions:

- The (communal) aspiration for an increase in educational governance—often with an emphasis on school and child and youth help, and often combined with a stronger orientation towards measurable results.
- The critical call for improved opportunities of participation (participation of adolescents and other groups of the population) and the implied processes of learning.

(Abstract) common features are the exclusive focus on the 'learning individual' and the exclusion of content-related subjects. A certain exception is the area of cultural education which is mostly understood as a holistic methodical approach and only partly in view of contents related to cultural subjects.

The great success of the term "educational landscape" in Germany can certainly be put down to the broad range of its conceptual contents as well as to the fact that both partial terms 'education' and 'landscape' are associated in the German language with a very positive or even romantic meaning. This makes it even more important to clarify the actual meaning of educational landscape in its respective communal/regional/local context and its targets on site.

In English-speaking countries, however, the term 'educational landscape' has a more special meaning and is related to individual areas of education, e.g. higher education, universities, schools (e.g. Coates 2010). In relation to its content, the German term 'Bildungslandschaft' rather corresponds to the concepts of learning cities/local learning regions etc.

In Germany, ESD has received only little attention within the general discourse on educational landscapes. Although, also in Germany, the term 'Sustainable Landscapes of Education' is being used quite often, this is done in another sense, merely referring to durable in time, i.e. long-term stability and not with reference to contents und goals in the sense of a SD. Also, there are only few (scientific) publications on the very new term "Educational Landscapes for SD" (ELSD) (e.g.

Stoltenberg 2013). Contrary to the general discourse and to most of the practical approaches to educational landscapes, the learning individual is not (just) explicitly being dealt with in the context of ESD although (But) the individual is right in the focus of all considerations and directly related to a series of important subjects of sustainable (regional) development relevant for the future, e.g. climate, mobility, nutrition… The ultimate objective always points at the acquisition of (The final target is always acquiring) possibilities of participation ('shaping competence'), especially at the concrete local level. Under methodological aspects, cultural education with its variety of creative possibilities of learning is also here highly significant for many groups of addressees (e.g. Kelb 2013).

At least in an implicit manner, ELSD has become subject of reflections and debates in those 21 cities and communities which were awarded in Germany within the label of the UN Decade ESD and is an official term in Osnabrück and some of the other communities. The Declaration of all lord mayors at the occasion of the final ESD conference (DUK 2014c) states amongst others; "*ESD is thus a major basis and orientation for the construction of our local and regional educational landscapes*". Although due to the different local conditions and backgrounds there are differences in the way these aims are implemented, the awarded communities as well as those nominated for the GAP unanimously agree on the significance of this aim for the coming years. This was also stipulated in a strategic publication of the DUK 2013 "*As regards the proposed strategic development of 'sustainable regional educational landscapes', it is necessary to reinforce the cooperation of all actors who can contribute to successful learning processes in a sustainable society. A precondition for this is the establishment and management of suitable high-qualitative and effective networks*" (DUK 2013, S.11, a more detailed description pp. 28–30). All this leads to the assumption that the term 'Educational Landscape of SD' (ELSD) will soon be firmly established in theory and practice.

The underlying concept of the German term corresponds also to the suggested major tasks formulated in the GAP at International level that intends to join the different actors for cooperation and integrate the different educational areas and subjects into a comprehensive concept. In my view, ESD should be considered as a necessary perspective and long-term orientation for all local educational landscapes which would change the future relation of ESD and education (Becker 2013, 2014, 2016).

6 Osnabrück—Many Steps on the Way Towards a City of ESD

It is important to know that sustainability issues, especially Environmental Education, Global Education and later the follow-up concept ESD have a long tradition since the beginning/middle of the 1980es in this city. An increasing number of actors (associations, organisations, projects and others) in almost all fields of formal, non-formal and informal education have been creating active processes.

A decisive part is also taken over by the commitment of many organisations of civil society and by manifold voluntary community activities of Osnabrück citizens.

For more than twenty years, a vivid and successful Local Agenda 21 (LA 21) is active in Osnabrück with working groups on several subject areas, and a "Forum Agenda" that meets at regular basis. A first solid product of the network and cooperation (stipulated by contract) was established in 1997 in form of a municipal "Centre of Environment Education" (in brief: CEE) in the "Museum of Nature and Environment". A similar construction developed within the 'Third-World-Centre' in Osnabrück. In 2002, the open Working Group Environmental Education (WGEE) of the Local Agenda 21 Osnabrück developed by the CEE in 2002 proclaimed right from the beginning ESD as its guiding principle. This Working group focussed its tasks on network building at local level, public relations on annual themes and related competitions for schools and other local institutions of education, and worked in close cooperation with the Osnabrück "Association for Ecology and Environmental Education" (in brief: AEEE) on many common projects (e.g. Becker 1997a, b, 2001). One outstanding example for the joint work of these two organisations at International level is their close cooperation work with the Baikal Information Centre GRAN in Ulan-Ude, the University at Ulan-Ude and several schools in Buryatia in Eastern Sibiria in Russia in form of intercultural ESD, above all in form of youth exchange programmes (Becker and Dagbaeva 2009).

Since 2005, the WGEE has been awarded five times by the German UNESCO with the label of *Official Projects of the* DESD, and the AEEE three times since 2009 for their excellent work for two years each. In addition to these two organisations and their numerous projects in the field of ESD, more and more activities gradually developed in Osnabrück that were directly concerned with ESD and similar subjects and objectives or actually assumed a similar orientation. This also led to new forms of cooperation or networks at temporary basis. From 2005 to 2014 more than 50 projects in the City of Osnabrück and in the near surroundings received an award for their outstanding work in the field of ESD within the frame of the DESD. In the end, the situation became more and more confusing so that it might have been characterized as a sort of 'untouched, natural' educational landscape. Nevertheless, little use was made out of this great potential implied for ESD due to the fact that the actors hardly knew each other, or that everybody was primarily self-absorbed. This problem was even reinforced by the decrease in staff and financial resources.

From this background and encouraged by the ESD Award label of other German cities, the WGEE and AEEE took the initiative in 2012 and tried in a joint action to convince the local politicians and the city administration of Osnabrück to apply for the UNESCO-Award hoping primarily that a successful application would bring new impetus to the latent ESD in Osnabrück. This became more and more urgent in view of the decreasing commitment of the City of Osnabrück in the areas of Local Agenda 21 and environmental education/ESD in response to the urging austerity measures.

For this reason, debates were held together with all seven parliamentary groups of the political parties in the City Council which finally led to a successful outcome in April 2013: The Council of the City of Osnabrück unanimously decided to declare ESD to be a central element of the guiding principle of all educational policies of the city. This was one of the preconditions for the awarded label 'City of DESD' by the German Commission of the UNESCO in August 2013.

The time-consuming processes of application for the award was taken over by the WGEE and AEEE (mostly on voluntary basis) as no staff member of the municipal administration neither had the sufficient time nor felt competent enough to cope with challenging task.

Also other cities that were awarded with the ESD label had entrusted particularly committed actors with the application procedure for ESD, mostly NGO staff. Successful work of ESD at local level requires a sufficient number of actors and a good form of cooperation with the respective municipalities. Once having been awarded, this success will generally produce strong impetus to expand this cooperation at local or regional level and consequently implement, extend and improve ESD more strongly in all areas as an efficient measure of SD in these cities.

7 Survey of ESD Activities in Osnabrück

Takin stock of all activities and contexts of ESD was an indispensable requisite for submitting the application in spring 2013. As so far nobody in Osnabrück had been able to set up a clear overview, this proved to be more complex and time-consuming as had previously been expected, even for the WGEE and the AEEE who had volunteered to take over this task on behalf of the City of Osnabrück. Already before the label had been awarded, the inventory was being published step by step on the new designated website http://www.bne-osnabrueck.de in order to inform all actors about all affiliated members before starting redeveloping the network of cooperation. In August 2013, the UNESCO officially pronounced the award and combined its decision with great praise for the diversity of actors and projects. Due to the complex character of stock taking, we shall refrain here from going into too many details. For a better overview, seven groups of actors and projects were defined which already cooperated in most different areas in smaller networks. Although the administration of the city is only explicitly mentioned in the final two groups, it has to be stressed that with regards to content the different municipal departments were often involved in projects of other groups and supported them. Admittedly, the cooperation amongst the city administration and actors within civil society still needs further improvement and a reinforced support by the City authorities. This is one of the long-term perspectives of the Osnabrück LESD which, at this stage, did not bear this official name yet.

Group 1: The **WGEE** comprises a cooperation of representatives of important institutions, such as AEEE, CEE, Museum Nature and Environment, Green School in the Botanical Garden of Osnabrück University, Technical-ecological Learning

Site 'Nackte Mühle', Museum Industrial Culture, Zoo Osnabrück/Zoo School, Centre of Environmental Education 'Noller Schlucht',…and committed individual persons.

Group 2: 43 projects, organizations and networks awarded with the label of *official projects of DESD* by the German UNESCO. In addition to the organizations WG EE and AEEE that had been awarded 5 resp. 3 times, and some projects of other members of the WGEE, the following projects of other organizations and private business enterprises from quite different areas were also awarded in the City of Osnabrück: 3-Berge-Projekt (3-Mountains Project with 8 supporting organizations), WABE-Centre (Nutrition, sustainable production of food, University of Applied Sciences Osnabrück), Osradio (Citizen's radio), Terre des hommes Osnabrück (For children, their rights and equitable development) and *Help Age Osnabrück* (humanitarian charitable organization for the rights of older people), Center for Environmental Communication (ZUK), *Niedersächsische Auslandsgesellschaft e.V.* (Foreign Society of Lower Saxony: intercultural projects for sustainability), CookUOS (Project for sustainable nutrition—University of Osnabrück), Studienseminar Osnabrück (Practical Teacher Training—Vocational Training), *Möwe gGmbH* (Reutilization of used materials), *Neue Osnabrücker Zeitung* (Local Newspaper with projects for schools); *Hellmann Worldwide Logistics* (Project 'Students learn Sustainability—Vocational School network'). Furthermore, there were seven other organizations/institutions from the direct surroundings of Osnabrück that received the same award.

Group 3: The Local Agenda 21 Osnabrück with a forum, thematic working groups (environmental education, energy, building and living; urban development and traffic, home and living at old age; fair trade; peace garden), sustainability days at a yearly base since 1994 (with support of the city administration).

Group 4: **Institutions of Education and Science** with the general principle of ESD and ESD practice, e.g. University of Osnabrück; University of Applied Science Osnabrück; Adult Education Centre Osnabrück; Music- and Art School, many of the approx. 80 schools in Osnabrück providing general education, many nurseries…

Group 5: Parts of the following **three networks**, operating now for 10–15 years, are closely connected to the work of Agenda 21—each with numerous participating organisations: Development-political work—Action Centre 3rd World—Fair Trade; Round Table CO_2—Osnabrück Climate Alliance—Project City of Climate; Osnabrück Environmental Forum (all organisations for protection of nature).

Group 6: Osnabrück—City of Peace: On basis of the conclusion of peace in 1648 after the *Thirty Years' War*, Osnabrück is proud to be named the City of Peace which is reflected by many activites for promoting a culture of peace, regular intercultural/International events as well as by regular exchange and relations with 11 different partner towns, represented each by their ambassadors: Angers (France), Çanakkale (Turkey), Derby (England), Evansville (USA), Haarlem (Netherlands), Hefei (China), Twer (RUS) und Vila Real (Portugal) … It is not possible to achieve sustainable development without peace and intercultural understanding. This is

another reason that proves that the cultural dimension of SD is so important and indispensable (see Sect. 3)!

Group 7: City administration: At this level, there are many examples from different areas which either link civic actors in a cooperative manner or where vivid controversial debates are held in public. Example: Early participation of citizens in measures of urban development planning and of traffic planning (Mobility 2030 of the Municipal Utilities Campaign Cycling…), integrative intercultural projects, Fair Trade (City was awarded with the label *Fair Trade Town*), climate protection (at present the model project *Masterplan 100 % Klimaschutz,* financially supported), *Grünes Netz*—(Green Network of relevant ecological sites in the urban district), *Saving Energy at Schools* (management of properties and buildings by the City administration, carried out by the AEEE). The long-term project '*Revitalisation of urban flowing waters*' is a good example of how the City deals with future-related subjects: Since 1998 approx. ecological, constructional, cultural and pedagogical measures have been organised in a systematic manner for revitalising the river 'Hase' of the City (Living '*Hase*') in cooperation with organisations and institutions, again and again with support of external sponsors. The network "Schools for a living Hase" is being coordinated and further developed by the AEEE on behalf of the department *Environment and Climate* of the City of Osnabrück. It is envisaged to expand the network with participation of the university and about another 10 educational actors/organisations.

Although the actors of the groups 4–7 played a very important role for the development of ELSD at Osnabrück, it was not possible to take them into consideration in the following. Particularly worth-while mentioning is the development-political area around the '3rd World Centre' which has been active as long as since the beginning of the 80s. The same holds true in a similar manner for the field of action "peace culture" which is of central importance for Osnabrück, the City of Peace. In view of the present world situation, the importance of Intercultural Education for Peace becomes more urgent than ever, unfortunately still rather detached from ESD not only in Osnabrück.

8 Building Educational Landscapes for Sustainable Development in Osnabrück

The German Label 'City of DESD' in 2013 gave strong impetus to ESD and to a broader conception of a more comprehensive ELSD in Osnabrück, and initiated many processes of stronger linking the individual educational actors in view of their common goal. The department "Urban planning and Integration" of the City administration which was responsible for LA 21 until the end of 2014 established an official Working Group ESD for Osnabrück (WG ESD) which included the initiators of the application of the City (WGEE and AEEE) who continued to take over a leading part as far as promotion and expert knowledge was concerned. In addition, the speaker of LA 21 also participated in this WG ESD and the communal

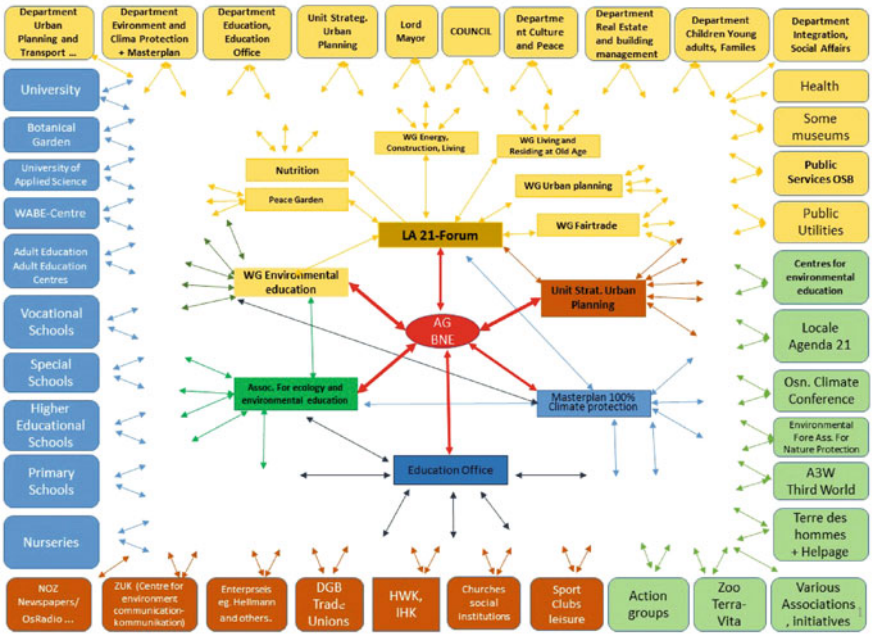

Fig. 2 G. Becker: Landscape of ESD Osnabrück: actors, structures and potential 2013–2015

'Educational Office'. For some years, the educational institution had been engaged in developing in Osnabrück a region for consistent education (within the frame of the National project 'Lernen vor Ort' ('Learning on Site'), which also included the concept of Educational Landscape. Soon the term ELSD was officially employed as a perspective of an ESD process in Osnabrück. An illustration of LESD is shown in the following graphic (the arrows in Fig. 2 near to the actors at the external margin are to be understood symbolically).

As at this stage, additional resources for this BNE processes were not granted by the City, the following major activity could not be organised before the event '*Day of Sustainability 2014*' in November 2014 which was conceived as an event of the LA 21 with the aim of broadening the perspective. This half-day activity under the heading "Together for a sustainable Osnabrück—Landscape of Education for sustainable development" was mainly organised along the lines of the method *Worldcafé.* Intensive discussion took place at eight thematic-tables (Nutrition, Fair Trade, Health, Climate Protection/Energy, Culture, living and residing at old age, municipal development/transport and as a cross-sectional subject ESD) with alternating participants. The most important ideas were presented in the final plenary session and published immediately on the respective Website (www.bne-osnabrueck.de/NHT2014). A detailed documentation of all ideas and suggestions was published in spring 2015. The following proposals by WG EE and AEEE have been implemented, prepared or intensified:

- Establishment of a quarterly '*Dialogue-Forum ESD*'. The following first subjects for are:
  - Nutrition education for sustainable development (April 2015),
  - Teaching sustainability in daily school life—but how and with whom? (July 2015)
  - Vocational ESD and sustainable mobility (Sept 2015 at and with Hellmann logistics)
  - Immigration/Refugees and BNE (Dec. 2015, preliminary)
  - 2016: Climate change, Faire Trade, …, (suggestions)
- The *ESD Newsletter* already published since end of 2013 by the WGEE was enhanced and intensified and sent to a broader circle of addressees
- Improvement of the website www.bne-osnabrueck.de
- Interviews with ESD-actors with publication on the website and radio broadcasts at regular intervals (www.bne-osnabrueck.de/Interviews)
- Further preparation of the organisation of the *7th Agenda competition* on the subject "Climate Education" with a programme and events in 2016 within the frame of the programme *Masterplan 100 % Climate Protection* of the City.

9 Future Perspectives and Problems

All other suggestions made at the "Day for Sustainability" will have to be examined in the LA 21 and to be implemented, at least partly. Other important areas had been represented only to a very small extent or not at all, such as e.g. the area of Development Policies/Global Education and Peace Culture/Intercultural Peace Education. In these aspects, there are only few ideas for a better networking in the field of ELSD of Osnabrück and its surroundings.

The entire process of ESD in direction of ELSD needs to be supported by new resources of the City of Osnabrück and to be reflected in binding structures together with the most important actors. The current form of operation by means of mostly voluntary activities will not suffice for a stable basis for the future. Whether such a safeguard at community level succeeds at medium range in Osnabrück, will depend largely on the implementation of the "Strategical Targets of the city 2016–2020", focussed on urban planning that is fair and just under social and environmental aspects, sustainable mobility, environmental consciousness and protection of the natural resources and which includes "ESD as an essential part of the guiding principal of the city's educational policies. The City of Osnabrück will ensure a diverse and inclusive offer of schools of higher education as well as vocational schools which corresponds to the needs of the parents and young adults."

In a further step, a liable plan of practical implementation will have to be worked out in a participatory process together with the actors; and necessary resources of staff and finance will have to be provided. In view of the required budget cuts for

the municipal household this is—like in other cities and towns—a very difficult task.

10 General Conclusions

As shown by the argumentation in this article, on basis of world-wide conferences and programmes on the central themes of humanity, we will stand a good chance in 2015 of better conditions for ESD in general and for the implication at local level in particular. This tendency is largely supported by increased importance attributed to ESD due to a clearer awareness that all these human problems are interrelated closely. Even if this is reflected in all resolutions of the conferences, however, this will merely procure a general framework and hopefully create impetus to be implemented and substantiated at all national, regional and finally also local levels. What is also needed in cities and communities is a strong political will, combined with a clear strategy on basis of a joint vision of sustainable development and education as well as a progressive plan for implementation that involves actors and citizens on site and promotes a stronger commitment and better education in all areas. Whether ELSD or Learning Sustainable City/Region is concerned; in the end all actors and stakeholders, teachers, educators, politicians etc. will have to understand: ESD is "*not simply a supplementary area of learning and activity but an overarching cross-cutting task*" (DUK 2014a, p. 10). In particular, all local strategies for sustainability should attribute much more significance to education than before.

The example of Osnabrück proves that such an immense challenge requires a radical modification of opinions and attitudes of all participants involved. Even constructive and feasible networking within a city and a region appears to be a quite difficult task, a process during which local authorities should adopt a coordinating, controlling, motivating and supporting role.

Successful examples worldwide show different ways and concepts for very different political and problem-related situations at local level. Under the aspect of exchange of knowledge and experience, it is not only helpful to reinforce communication and cooperation at trans-regional and International level, but an indispensable condition for successful global sustainable development.

This holds true in a similar manner, in particular for the university sector: Scientific research has to be more strongly oriented towards inter- and trans-disciplinary approaches, also towards approaches of 'Citizen Science' (e.g. Finke 2014). Last but not least from my own long experience in university teaching for ESD I would like to stress the advantages of a local approach for ESD for a practical and qualifying commitment which—at the same time—could be very useful for local ELSD.

This, perhaps utopian, idea of a 'learning global community' for sustainable development of many actively committed citizens strongly disagrees to neoliberal economic principles of development, which are unmistakenly unsustainable, not to

mention violent waging of conflicts. In this context, we must be aware of other challenges for SD brought about by increasing processes of migration and the urging problem of how to cope with the large number of refugees and their precarious situation in their countries of origin. ESD, therefore, must always imply intercultural education for peace and justice.

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Author Biography

Dr. Gerhard Becker Since 1973, Dr. Gerhard Becker has been working at the University of Osnabrück as a lecturer and researcher in the field of university didactic/educational studies. After his post doctorate in 1978 he dedicated his work in an increasing manner to environmental education, which led to the establishment of a separate subject area 'Environmental Education/ESD'. As a result and in relation to his academic activities at the university, more than 100 publications and many continuous practical projects originated outside the university out of which in 1990 approx. A central role was taken over in by the 'Verein für Ökologie und Umweltbildung e.V' (Association for Ecology and Environmental Education) as the supporting agency and cooperative institution of the University of Osnabrück. Since about 1993, ESD was coined as the new central idea and subject in university teaching, research and practical projects as well as cooperative efforts of networking, mostly in Osnabrück. Since his retirement, his academic work has been continued in a reinforced manner under the name ‚Umweltbildung für nachhaltige Entwicklung (UBINOS) '(Environmental Education for SD) and in cooperation with and at the University in form of practical projects of the association, the Working Group Environmental Education (WG EE) of the Local Agenda 21 Osnabrück as well as the Osnabrück 'Landscape of Education for Sustainable Development (LESD). Selection of present functions: Chairman of the association, speaker of the WG EE and of the WG ESD of the City Osnabrück for the construction of an LESD in Osnabrück. Member of the national working group 'Communities and ESD', member of the Commission 'ESD' of the German Association for Education Research—DGFE, Head of the Project for the Online Data Base www.bne-literatur.de.

Involvement of Advanced Level Students Using Ecological Modelling in Research About Regional Sustainability

T. Skytt, S. Nielsen, E. Grönlund and M. Fröling

Abstract

The purpose of this paper is to present a pilot educational project where ecological modelling has been used to integrate advanced level students into the research about regional sustainability. Addressing regional sustainability with an ecological systems model based on carbon and energy balances is a way to understand the basics of sustainability integrating detail and holistic views. Such model has been developed in a case study on the Danish island Samsø, and currently a similar model is now being developed for the Jämtland county. Even though Jämtland, located in mid Sweden, is a sparsely populated area with large forests, a lot of hydro power, and only one major city, it is still not obvious how to reach long term sustainability. For educational purposes ecological models are excellent tools, since complex interactions can be studied, analysed and discussed in a structured way. It can be expected future sustainable society development presupposes integration between research and education, thus building a long term strategy for the possibilities to change negative cultural patters of whatever kind these might be. To strengthen the authorisation of the education for sustainability, clarification of the university's integrative role in society may well be used, to give students self-confidence for continuous development within the field.

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Regional sustainability · Ecological modelling · Role of the academia · Educational involvement · Carbon balance · Work energy balance · Education for sustainability

1 Introduction

The department of Ecotechnology and Sustainable Building (EHB) at Mid Sweden University in Östersund educates eco-engineers, eco-technicians and eco-entrepreneurs and aims at giving the students a broad and holistic education with ecological and engineering basis in societal problem solving. EHB is working on a research project aiming at modelling the county of Jämtland, targeting regional sustainability. The aim of this project is an ecological model ('Sustainable Jämtland') evaluating regional sustainability out from the indicators carbon (to calculate CO_2 emissions) and work energy (available energy) as sectorial input and output, following a model developed for the Danish island Samsø. In the pilot educational project presented in this paper, advanced level students at the International master's program in Ecotechnology and Sustainable Development have been integrated in the work of the 'Sustainable Jämtland' project during a 10 week full time course. This offered a variety of challenges to the students (and for the teachers) which, in a realistic manner, will introduce them to the world of research and science, as well as the complexity of sustainability evaluation and environmental modelling. Connecting students with a real research project has the advantage of giving opportunities to get insights in work processes like proper planning ahead, problem definition for instance by means of systems analysis, determination of necessary data for understanding the system and its processes, data acquisition and problem solving. This is done by giving a variety of options connected to a specific problem which will eventually improve societal conditions with respect to improve the actual level of sustainability. At the same time some insights are gained concerning the connection of the problems of sustainability to the everyday life and the span of problems met from laymen through practitioners, through managers to political level. For the research project it has the advantage that new ideas and information are being added, as well as a lot of fruitful discussions.

Mid Sweden University was 2014 invited to be part of the steering committee of the county's climate council (a position held by the headmaster). Furthermore the university also took the initiative to be part of the working group of the council where stakeholders are expected to contribute actively. EHB was appointed from the university to take this role, which also will strengthen the department's role within sustainable education and development. The model will be used for evaluation and discussion within the regional council.

There are many papers highlighting the importance of connecting education in sustainability with real life situations and experiences through case studies [for example (Brundiers et al. 2010; Karen et al. 2010; Littledyke et al. 2013; Morse et al. 2007; Zilahy and Huisingh 2009; Scholz et al. 2006). The importance of such case studies needs no further argumentation. These papers also discuss the educational challenges when teaching sustainability, as well as the necessity of developing a strategy and a network for how to find ways for inter- and/or transdisciplinary methods and the involvement of experts one way or the other. The experiences from three universities (England, Australia and Greece) in Education for Sustainability are presented in a paper by Littledyke et al. (2013) and discusses the necessity of internal university coordination as well as the role of the university in the society. An interesting comment in their paper is the need for "identifying the roots of language" when it comes to analysing sustainability (p. 377). This is easily forgotten, but when it comes to sustainability issues it is probably most important and should not be forgotten since students often have feelings that they already know what sustainability is and how it can be achieved.

The experiences from Wageningen University presented by Karen et al. (2010) are most valuable since there are many similarities with the pilot project at EHB. Also the approach used at TCS in Zürich (Scholz et al. 2006) show similarities and they point out the necessity of defining the problem to avoid ontological dilemmas from ill-defined problems (p. 233). They discuss their epistemological approach with a normative and systemic sphere, where the systemic sphere can be seen as a hierarchy: understanding—conceptualization—analysis (p. 234 ff). The paper give a very good theoretical background to their structured methodology used in the education and such information is very useful for how to make improvements as well as deepening the understanding of didactics used.

This paper presents the experiences made at Mid Sweden University about (1) the role of the university and (2) what tools are needed and what knowledge that needs to be developed serving a base for regional working strategies towards regional sustainability, also (3) involvement of advanced level students in the research project. Since research about the educational part as such has not been performed, this paper focuses at a description and an analysis of the pilot education project, where students have been directly involved in a research project working with systems modelling without prior experience in the field. It has to be taken into consideration that some kind of educational failure always is a risk when working this way, but if the risk can be taken it is worth trying to test out educational ideas about how to teach sustainability, combining it with input to a research project.

The outline of the paper is as follows: Part 2 gives the background to the regional situation and the research project as well as the methodology used in the course. Part 3 explains and discuss the role of the university which is an important aspect of the general educational part. Part 4 presents tools and knowledge needed to teach sustainability out from experiences made at EHB. Part 5 summarizes the experiences from the involvement of the students in the research project is presented. A summary of our conclusions can be found in part 6.

2 Background and Method

The Swedish government proposed out from the directives and recommendations from EU a combined climate and energy politics 2008, decided by the parliament 2009. This includes a 40 % reduction of GHG emissions until 2020 (compared to 1990) for non-tradable GHG emissions (Regeringen 2008). For tradable emissions there is a framework within the EU directives controlling emission targets. The vision for 2050 is zero net CO_2eq emissions, which has also been presented by the Swedish Environmental Protection Agency as "2050 A Carbon Dioxide Neutral Sweden" presenting a plan for a climate sustainability on a national basis (Naturvårdsverket) with a detailed roadmap how to achieve this (Naturvårdsverket 2012) and (Naturvårdsverket. (n.d.)).[1] Out from these decisions and visions the Jämtland county[2] has worked out a climate strategy containing a sector overview at a regional level with reductions connected to the national targets (Länsstyrelsen Jämtland 2014), but somewhat more ambitious (NT = National Target; BY = Base Year):

1. 50 % (NT 40 %) reduction of GHG emissions by 2020 (BY 1990)
2. Increase energy efficiency with 30 % (NT 20 %) by 2020 (BY 1990)
3. Increase export of renewable energy from the region with 25 % by 2020 (BY 2012)
4. Increase knowledge and awareness in all sectors about the situation[3]
5. Vision of a fossil fuel free region by 2030

As can be seen the targets are rather ambitious for the region. Following the discussions about local sustainability EHB[4] decided 2014 to start up a research project aiming at building a detailed ecological model of Jämtland. Based on the experiences made at the Danish island Samsø, it was decided to try to upscale the methodology being developed at Aalborg university in Copenhagen (Nielsen and Joergensen 2011) and (Nielsen and Joergensen 2015). This methodology includes an in depth modelling of carbon and energy flows for Samsø out from suitable sectorial breakdown. By focusing only at carbon and work energy in the analysis, knowledge and deep understanding of the conditions within the sectors could be gained. This balance between the detailed view and the holistic view seems to have been successful, making it possible to close up sustainability using only two

[1]Including detailed attachments.

[2]Sweden is divided into 21 administrative units each one consisting of several municipalities. A municipality is both an administrative as well as a political unit. Jämtland county consists of 8 municipalities.

[3]Including for example increased insight how consumption and travelling cause GHG emissions outside the region/nation.

[4]The department of Ecotechnology and Sustainable Building Engineering, Mid Sweden University.

indicators. However it needs to be remembered that carbon balances do not include all GHG emissions, but definitely a major part.[5] Other emissions can be included as separate balances later on to make overall numbers direct comparable with other GHG statistics created on regional and national level. Shortcomings by using only these two indicators are that they do not cover for example biodiversity or toxic compounds. Such problems needs to be dealt with outside the systems model itself.

The Samsø evaluation methodology and modelling were found to offer a suitable tool for how to work out a trustworthy sustainability analysis of a region, still making the results communicable outside the academy which has been a very important aspect. Samsø with about 4000 inhabitants is however a rather small region with less complexity compared to Jämtland with about 127,000 inhabitants. The county Jämtland has been divided into sectors covering the major activities in the region; (1) *Energy*,(2) *Forestry*, (3) *Industry*, (4) *Public*, (5) *Tourism*, (6) *Private*, (7) *Reindeer herding*, (8) *Agriculture*, (9) *Nature* and (10) *Waste*. Subsectors are included as for example the activity of *Transportation* which is an activity taking place in several sectors. As this is a main focus in the climate strategy for the region it might be necessary to treat this part of sectorial activities separately.

The students in the course at EHB came from different countries [compare (Karen et al. 2010) where also the student group was highly international] and worked in pairs. They could freely chose sector and indicator to model, out from interest and curiosity, and none of them had any previous knowledge about ecological modelling. Of course it was not expected that they would be able to finalise redundant and complete sectorial models in ten weeks, since this is a rather demanding task. The focus was to learn about the sector and find data to make modelling possible and to be used in the research project. A system modelling approach is an engineering way of looking upon the environment, and to be able to build the model not only data and calculations are needed but also complex knowledge are to be built up. It became obvious for the students that if the modelling was done before the sector activity was really understood, nonsense was all that came out of it.[6] As discussed by Boyle (2004), sustainability engineering requires a certain degree of maturity as well as the ability to understand complex systems, and solutions cannot be presumed to be found within traditional engineering spheres (p. 149). The problems highlighted in the article [maturity of students, knowledge among lectures, acceptance, lack of textbooks, lack of examples and lack of time (p. 152)] are important to make also the students aware of, thus making them understand sustainability issues remains unsolved because they cannot be attacked with simplifications or existing knowledge only. It was

[5]One example is SF_6 leakages from high voltage switchgear equipment. The gas contains no carbon but is a very aggressive GHG with a CO_2eq index of about 23,000 (1 kg SF_6 corresponds from a radiation aspect to 23 tonnes CO_2eq).

[6]Actually examples of this could be found in the beginning of the process among students starting too early with the modelling, before true understanding of the sectorial complexity had been gained. This is however also part of the learning process since it gets more and more obvious, making it in a way self-regulating.

clearly communicated to the students that modelling is a scientific method and the result will depend on the collection of data and the structure of knowledge built in. (Kates et al. 2001) discuss the approach needed for sustainability science in terms of a science that differs in structure and method compared to "science as we know it" (p. 641). Such messages however, need to be treated with certain care since there is a risk that students understand this as if the *scientific method* as such can be questioned, and this should be avoided.

In the first phase of the course the students had to start with making simple models of limited systems and problems (this was done in the STELLA® software, starting with population models to fit historical data and predicting the future). In parallel they were given lectures in different subjects by different experts (modelling theory, thermodynamics, GIS, systems thinking, forestry, sustainability). Minor evaluation of the students' modelling capabilities was done and finalizing the first phase the students had to present their project plans and working methodology to be used in the following phase. In the second phase they worked with their sectors as projects with the teaching team as a steering committee (in the way development projects often are organized in companies). In the beginning of this phase also an ecological modelling expert was being introduced supporting the work by the students.

Visiting the "real world" was another important part of the course. Visits were made at an active forestry site, a dairy farm (a typical regional farm with about 100 animal units) and a hydro power plant (80 MW), giving the students direct access to real-world information and stakeholders. As pointed out by Brundiers et al. (2010) it is most important to do this before "simulating the real world" enhancing the students' research skills and they discuss the fact students are "normally unfamiliar with concepts and practices of real-world learning" (p. 320). Problem solving within sustainability demands certain skills, and the ability to collaborate with experts and stakeholders is most important to be able to build understanding of the system to work with (p. 308). Also it was found most valuable to have "real references" to verify results and ideas.

The final evaluation of the student projects was based on two products from the students. The first was part consisted of the elaboration of a poster and presented at a seminar where all students were present. The posters were evaluated mainly based on their efficiency to communicate results in a clear manner to stakeholders. An additional benefit by letting students give such a presentation is that it allows for a more detailed discussion of (1) both specific problems which arise when working with a model in a particular area as well as (2) the general, typical and technical problems that arise almost by all working processes during development. Such a discussion is fruitful as it allows a discussion of common experiences shared by all groups. The second part was an elaboration of a report which at the basic level teaches students to make a proper model documentation including self-evaluation of all phases from a problem description and formulation, assumptions made and used in the simplification, through presentation and evaluation of results. At the same time the students gain insights in the scientific work processes, judgement of data quality (implicitly quality assurance) and learn basic skills as scientific formulation, requirements of sufficient documentation, reproducibility. By this students indirectly

learn about many principles normally only taught in a theoretical manner in the topic of philosophy of science. Using the above described approach it comes out as a necessity, shaped and determined by the practical working process instead.

3 The Role of the University

The role of the university is important to clarify when it comes to sustainability work, thereby making it possible to communicate to the students and other stakeholders how their contribution influence reality. Searching regional information is easier if it is just not "another student project". When it comes to roles in society, stakeholders can chose a role 'given' a role. Concerning the role of the sciences, UN states in Agenda 21 (United Nations 1992, p. 311):

> One role of the sciences should be to provide information to better enable formulation and selection of environment and development policies in the decision making process. In order to fulfil this requirement, it will be essential to enhance scientific understanding, improve long term scientific assessments, strengthen scientific capacities in all countries and ensure that the sciences are responsive to emerging needs. [—] The sciences can provide this understanding through increased research into the underlying ecological processes and through the application of modern, effective and efficient tools that are now available, such as remote sensing devices, robotic monitoring instruments and computing and modelling capabilities.

Furthermore, Agenda 21 points upon aspects such as the necessity to bridge the gap between the academic world, policy makers and the public. The educational mission is (among other things) enabling an integration of continuous scientific development with the process of achieving sustainable societal development. Zilahy and Huisingh discuss the role of the academia and point upon the possibility for universities to build bridges among "a wide array of network actors" and take different initiatives in regional development (Zilahy and Huisingh 2009, p. 1059). They have been investigating how members of academic institution can contribute to regional sustainable initiatives. Results from their investigations show that working at the regional level seem to be appropriate, making problem solving possible which otherwise would cause difficulties both at higher (national) and a lower (local) level. Applying a holistic view is necessary since a region offers complexity and a variety of problems. Weaknesses have been seen when regions are not well defined, or when there is a lack of authority. A university can offer authority, at the same time there is a tendency of "isolation from real world problems and a lack of motivation/interest toward outreach activities…" (Zilahy and Huisingh 2009, p. 1065). Zilahy and Huisingh recommend HEI (Higher Education Institutions) to aim at long term engagement taking an active role, applying a holistic and multidisciplinary approach both within the academy (facilitate communication and co-operation between different disciplines and departments) and between external stakeholders. Another interesting outcome from their surveys is that many responders pointed upon the

advantage of student involvement trying to find solutions for real world problems, thus improving awareness etc. and help them become more 'sustainable' citizens in the future (Zilahy and Huisingh 2009, p. 1062).

Taking into consideration that the counties in Sweden are well established with clear boarders and authority in leadership, there is no reason for Mid Sweden University to take a leading position. Instead it serves society better to take an expertise role, supporting the decision making in the regional climate council with evaluation tools. An ecological model of Jämtland gives a holistic and at the same time very detailed view of the region, allowing for determination of targets of major importance and where measures can or should be taken. The development of such a model has to include continuous cooperation with other stakeholders, which is necessary to prevent misunderstandings when interpreting statistics and calculating balances. Each sector needs to be penetrated and understood in detail to make sure the model will be useful and trustworthy. The one responsible for the project needs develop into a 'regional expert' and this role will strengthen also the possibilities to build networks.

Dlouhá et al. (2013) conclude out from case studies in teaching and learning, HEI need to enhance the social networking remembering knowledge is always embedded in a social and physical world and problems are to be solved within a cultural context (p. 102 ff). Lifelong learning for sustainable development is an important part of the 'third role' of HEI and they argue that the involvement of external stakeholders beyond formal education is important to succeed in increasing understanding at different levels of the society. This makes it necessary to find effective ways to inform and educate stakeholders.[7] The ambition in the course at EHB was to give the students a clear view of the over-all aims and organization of the climate work of the county, thereby making them understand they were part of a most significant research supporting how to work out a real strategy for the sustainability of the region. At the same time they act information carriers about research within the university.

Not to forget the individuals in this, it is worth stressing the words of Overson Shumba, Professor at the Copperbelt University in Zambia: "Teachers need to be empowered to act as bridges between climate scientists, students and communities" (UNESCO 2015). How to empower the teachers might however be an open question, but a certain degree of individual conviction when it comes to the importance of the educational mission is certainly one of the important ingredients how to convince the students.

[7]One of the problems involved is often cultural changes are necessary in sustainable development processes. Old cultural patterns need to be shifted towards new patterns based upon the awareness of environmental effects of specific actions.

4 Tools and Knowledge for Educating Sustainable Development

Teaching sustainability poses many problems as the didactic situation immediately is met with two different obstacles. Not only does the tutorial action suffer from (1) the vagueness of the definition of the concept to be taught and to be learned by the students—but also from (2) the fact that the various disguises the concept can take on (human, economical, societal, environmental and at latest 'spiritual'). The two obstacles when mixed, result in an inherent complexity of the issue that for this reason alone makes it different to formulate in a strict manner that is easily comprehensible to students. How does one teach with, or learn concepts with at best obscure definitions spanning over a variety of topics which represent an extreme range of multidisciplinary? Several papers discussing this problem has been presented earlier and the "bridges and barriers" identified by Morse et al. (2007) are important to be aware of. They summarize their findings in three tables headlined *Individual*, *Disciplinary* and *Programmatic* bridges and barriers. It is obvious from their evaluations (not surprisingly) that tolerance, mutual interdisciplinary understanding and positive team work are most important aspects. What is also pointed out in their article is "Tools such as GIS and statistical modeling techniques that can integrate data at different scales have emerged as bridges to the successful generation of interdisciplinary knowledge" (p. 9). This corresponds to the experiences made in the course at EHB by using the modelling tool STELLA®. It was found that working with data collection out from the demands of such tools forces the students to go deeper into the complexity to build accurate models. In the light of transdisciplinary sustainability education through unifying arts, sciences, and community promoting learning about "the three pillars of sustainability (i.e. environmental, economic, and social)" as presented by Clark and Button (2011, p. 50), the methodology used at EHB might appear narrow. In their article they discuss reflections on the environment and nature out from creative art to "think deeply about landscape and the environment" (p. 46). The didactics behind this differs however quite a lot compared to the direct scientific approach chosen at EHB where the details in society are to be understood, following Brundiers et al. (2010) when they say "The devil is in the details" (p. 313). If the details are not understood, there is a risk the over-all picture grasped might mislead us. This is the philosophy behind the need to map a region on a detailed level, thus building bottom-up holistic understanding. People often show a preference for a top-down approach, grasping "the larger pictures", but there are risks involved in this which can be seen when working with systems modelling. The didactics used in the course at EHB also included the presentation of different ideas about sustainability (news articles, papers, reports etc.) to enhance personal reflection. But using also poetry and art as used by thereby broadening the input (Clark and Button 2011) is really an interesting idea worth considering for the future.

People generally react with confusion when facing a certain level of complexity [see for example (Meadows 2008)]. We are on one hand not 'systems thinkers', on the other we are not able to dissect complex systems into its various components, nor are we able to determine what are the most important elements to concentrate on both in a quantitative and qualitative manners. The lack of such a capability gives raise to problems when defining, working with and consequently teaching and learning sustainability in the broad sense. In this context it might be worth remembering the words of the Finish philosopher Georg Henrik von Wright about the mission of the conscientious philosophical writer; giving his readers "insight into the difficulty of the questions and the uncertainty of the answers"[8] (von Wright 1993 (1957), p. 5). This is in a way one of the most difficult insights to cope with, since most people expect (hope) knowledge will offer simplification and understanding. What is being offered is rather the opposite; increased complexity and confusion. This is, however, one most important part of education for sustainability!

The discipline of ecological/environmental modelling seem to offer tools for simplifying a system, i.e. reducing them into its most important components in a dynamic sense, as this is at the very crux of the establishing of all models At the same time the simplification leads to a reduction of complexity to a level where it is at least more easily comprehended. Therefore modelling can be used as planning tool and unifying concept in environmental teaching. Experience has shown that during relatively short term classes it is possible to achieve the development of fairly robust and almost realistic, and sometimes even publishable models. The process of first time development can be improved considerably through stringent planning following procedures such as "conceptual modelling" as described by Jorgensen and Fath (2011, p. 19 ff) and Nielsen/Patten.[9]

To be able to model a system successfully, it is necessary to know the system to be modelled in depth without getting lost in the complexity of the details, thus never be able to find a find to finalise the model into something useful. This is a balance and continuous communication and cooperation with stakeholders knowing the specific system is necessary to be able to find an appropriate level to work at. From the regional level it is necessary to define suitable sectors and thereafter identify key players and stakeholders within each sector, as well as define input and output parameters. The large model should be built from numerous sub-models and each sub-model needs to be verified and tested separately to make sure it behaves as supposed to.

[8]Translated from Swedish.

[9]Nielsen and Patten, unpublished Tutorial Material.

5 Involvement of Advanced Level Students

The decision to use modelling as the frame for the course origins from the research project 'Sustainable Jämtland'. The idea to force students to think in systems is enhanced by the logical structure demanded to build models of the system studied. A system is constituted by various subsystems, each one reduced to a mathematical (logical) form. There is always a risk students produce unrealistic models (not corresponding with reality) to attain an attractive mathematical solution. System approaches are sometimes criticized for this, and this was also communicated with the students to make them aware about the risks with reductionism built into models of reality. However the alternatives are no better in this sense. Knowledge about reality needs to be captured and logically structured to be useful in a broader context. This philosophical part of the course was discussed (but maybe not always fully understood, which matters less).

Some students confessed after the course had finished, they were really confused in the beginning about what was expected from them and Brundiers et al. (2010) have expressed this as students want to know "exactly" what is expected from them which cannot easily be stated in sustainability education, especially not in "real-world learning" (p. 319). To avoid too much critique in the beginning of the course we tried to communicate, as clear as possible, exact instructions would not be given. The students were expected to work as researchers and were responsible for their own education as well as knowledge building. Throughout the course they were however personally coached in their specific area. All groups continuously received articles and reports etc. (through the common web-based learning platform used at Mid Sweden University).

An important issue we wanted to avoid was having students jumping on conclusions about how to reach sustainability before having mapped their sector. Such a tendency can sometimes be found among students (and also others) working with sustainability. We also tried to avoid to ask specific questions since these might limit the sphere where to look for answers. Taking an example to this; "how can society switch from fossil fuels to renewables?" used by Karen et al. (2010, p. 19). We need to be aware that this way of asking questions already limits the sphere where to find possible answers. Too often answers are presented as "solutions" to societal problems, but if there were simple and economic reasonable solutions, we have to presume these would already be activated. Questions starting "How…?" imply other answers and thoughts than do questions starting "Why…?" or "When…?", and this is important to take into consideration when it comes to sustainability evaluation and analysis. It is also necessary to communicate the shortcomings of science and be aware of the risks with scientific-technological rationality and how it might influence our way of apprehending reality (von Wright 1986, p. 64).

It was interesting to follow the learning process notifying the changes in the students' apprehension of the sustainability dilemma and how to find solutions. One example was students working with the forestry sector. The students working with this sector realised that the carbon balance of larger forest areas are more or less

zero, with no surplus uptake (or emissions) of carbon in a longer perspective. From the beginning they had the idea, which is not too uncommon, forests are some kind of continuous CO_2 storages.[10] Studies show production forests capture more CO_2 than do nature forests due to faster biomass growth (Poudel 2014). The students were faced with the challenge of finding ways how to use the large forest areas of Jämtland to increase CO_2 uptake. Biofuel production is normally a zero sum game, where emissions from burning are balanced towards uptake during growth. They found out that the usage of wood as construction material, 'conserves' the carbon for longer periods, thereby making wood better for construction of houses compared to concrete or steel. If the cut trees are replaced with new planted trees this will increase the uptake.[11] Today there are no larger areas to be used for replantation with forest, if farm land is not to be used (which of course is one alternative to increase carbon storage and this was also discussed). A separate seminar was also held around forestry which resulted in interesting discussions about problems, ideas and solutions.

The students were encouraged to try to find out how the building blocks of their sectors work and they came up with numerous of questions. What is a tree? How do we calculate available energy for a hydro power plant or a wind mill? What is actually a tourist and in what way is tourism positive? What is the functionality of a cow in terms of energy transformation? (This latter question led to a couple of students performing bomb calorimeter tests to find out the actual energy content in hey and manure). From such building blocks sectorial knowledge was being built, which is a time consuming process (but also an important learning point).

In an evaluation discussion after the course, some students clarified that they were not used to approach an environmental problem with a system's (engineering) approach, structuring the problem as a model corresponding to a technological regulating system where each part is a unit controlled by certain inputs and outputs. They found out in depth knowledge about each part of the process was needed and they had to challenge their own 'prejudices' about sustainability. In the beginning of the projects several of the students were in stress due to lack of clear targets in their work. But they slowly realised they were in control of their projects giving them the possibility to steer individually out from the frames given in the large model, aiming at 'Sustainable Jämtland'.

As described by Karen et al. (2010, p. 32) we encountered some problems with students feeling a high pressure origin from a feeling of uncertainty about teacher expectations. (Karen, Fortuin, and Bush) conclude it is necessary for the teachers to deal with "the thin line between encouraging students to creative explore their data while minimizing the risk of undermining their confidence" (p. 33). Another problem we had was too few Swedish speaking students. It would have been ideal to have one Swedish native speaker in each pair thus making data collection and

[10]Of course the standing biomass represents a carbon stock, but the net change of carbon follows more or less the biomass change, except for minor quantities which can be taken up in the soil.

[11]The life length of the buildings etc. containing wood as construction material needs to be taken into consideration.

discussion with stakeholders much easier. (Karen, Fortuin, and Bush) had a Czech speaking person in each group, which seem to have been a most positive contribution. They also highlight the fact that working with real projects the students "were confronted with the shortcomings of scientific research and the often politicised nature of environmental management" (p. 33) and for some students a EHB it was obvious the shortcomings of the research actually origin in our own limitations finding accurate data and information and this is a most important learning point. We could also see that students with weaker logical thinking had some problems structuring the modelling from the information collected. Deeper training in logic would be positive but time is a limiting factor as always.

One major question remains in principle unanswered: how do we evaluate future outcomes of student's learning experiences? Do we really know that certain knowledge has been gained by the students or have they just passed another course? Out from the discussions held with the students during the course, it can be expected they really learnt a lot about sustainability, and for the moment this is the only proof this pilot educational project was a success.

6 Conclusion

The presented pilot educational project at the department of Echotechnology and Sustainable Building at Mid Sweden University, using ecological modelling as a frame for a course connected directly to a sustainability research project, seems to be an interesting way to educate for sustainability. Using a modelling tool forces students to structure data about regional sectors on a detailed level and out from there build systems knowledge (at a higher holistic level). Models needs to be fed with relevant data and functions and not interpretable words. As always there are shortcomings with this approach but it seems the positive aspects when it comes to educating for sustainability overrules the shortcomings (reductionism).

Working with real sustainability projects around a modelling tool enhances scientific methodology and the structuring of complex knowledge building. By connecting different experts (researchers) to the projects as well as visiting stakeholders in society, students learn to work with different kind of groups in the society. They also learn to value information and statistics to be able to verify and validate the functions of the model. Connecting students not only with research but also life outside the university increases their awareness about societal complexity and the world of contradictory information.

Care needs to be taken with students sensitive to vague curriculum definitions and high demand for information about expectations and requirements. Since life beyond studies are not very well defined, this is an important learning point. However teachers involved need to be aware of the problem, thereby continuously listening to the students and help them overcome their fear for not passing, not being good enough etc. It is also important to inform the students that they will in most cases *increase confusion* without really having a feeling they have gained

knowledge. In this sense a course like the one given at EHB, is not at all following a standard concept since the learning objectives will be abstract rather than understandable. When educating for sustainability, universities should not strive to educate students about what solution to apply, but rather equip them with knowledge about how sustainability issues can be analysed and understood, and not least, how information and data can needs to be structured to find new and suitable solutions.

It is important to show the students that they work toward regional sustainability. The research team will develop in the direction of regional expertise and this will also be the role of the university. The need for in depth knowledge can clearly be seen when working with sustainability issues. Since the complexity is large as well as the uncertainties, decisions needs to be taken based upon regional consensus. Universities belong to the few actors being able to supply knowledge out from trans-, inter-, and multidisciplinary perspectives aiming at solving the problems connected to the goal of increasing long term sustainability.

The cooperation between Aalborg University in Copenhagen having worked out the basis with the modelling of Samsø, and Mid Sweden University, now expanding the model of Samsø to cover the county of Jämtland, has been most fruitful and show academic cooperation and experience exchange are most positive and productive from many perspectives. In the eye of the students' and other stakeholders, experts "from abroad" enhance authority and give a feeling of broader cooperation for a sustainable world.

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Part II
Case Studies from Universities

Aligning Goals for Sustainable Outcomes: Case Study of a University Building in Australia

Usha Iyer-Raniga, Trivess Moore, Ian Ridley and Mary Myla Andamon

Abstract

The importance of universities goes beyond teaching and undertaking research. Universities can shape cities due to the significant number of buildings they occupy, large amounts of resources they consume and the high number of staff and students attending them. With many universities teaching subjects relating to sustainable planning, design, management, cities and society, they present an opportunity to lead by example and act as urban learning labs for a transition to a low carbon future. This chapter presents analysis from a post-occupancy evaluation of a Green Star rated university building in Melbourne, Australia. In addition to the analysis of building performance data, interviews were undertaken with key stakeholders involved across the design, construction and occupation of the building. A Building User Satisfaction survey was also undertaken for occupants. The analysis identified a number of key successes as

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well as a number of challenges. Learnings from the research are applicable not just to academic institutions but to the wider built environment industry in shaping the sustainability of the built environment.

Keywords
Case study · Green Star · Post-occupancy evaluation · Sustainability · Melbourne

1 Introduction

Education is central to the debate on sustainability, and when delivered successfully, plays an important role as a social change agent. Education for sustainability is not prescriptive. As posited by Tilbury and Mulà (2009), to reach goals for sustainability, learning in an active, exploratory, inclusive, creative, and responsive way is critical. Accompanying such learning-based approaches to sustainability is an acknowledgement that we need to rethink our dominant models of thinking, practice and communication; challenging our short-term approaches and limited understanding of life and living systems.

Leading organisations have recognised the role of education in making positive steps towards a sustainable future. The UN decade of Education for Sustainable Development (2005–14) recognised sustainability education as an important part of the curriculum in higher education. The aim was to integrate the principles of sustainable development into all areas of learning and to empower everyone to benefit from learning that motivates societal change. As an outcome for the Rio+20 Conference in 2012, Sustainable Development Goals were set, where it was agreed to address and incorporate in a balanced way, environmental, economic and social dimensions of sustainability. *The future we want* (UN 2012) document adopted at Rio, also placed education as an integral part of the sustainability equation.

The holistic and trans-disciplinary nature of sustainability education is seen as a challenge. The World Bank (2012) identified that higher education struggles to link higher education institutions with the wider world. Tanaka and Tabucanon (2014) state that universities are critical links for nurturing professionals possessing the skills and knowledge to cope in a world that is increasingly complex, trans-disciplinary and where employment may occur across differing geographic borders, yet recognising the natural limitations of the planet. The role of higher education to transform the way knowledge is created and shared is therefore, becoming increasingly significant.

1.1 Sustainability Education in the Built Environment

Sustainability education is a learning process and not a product (UNESCO 2005, 2007). Current ideas, concepts and knowledge itself are challenging the very foundational basis in which we learn and teach. The unique features and issues of

sustainability have a profound effect on the way academic curricula are structured. Informed by case studies and projects in Australia, Europe and the United States, Desha and Hargroves (2014) developed a 'whole institution approach' model on curriculum renewal on embedding sustainable development knowledge and skills within curricula for engineering programmes and identified the drivers and barriers to education for sustainability, organizational change, the key considerations for curriculum renewal and engaging in institutional collaborations and industry. Extending from the curriculum to campus greening has been advocated by Nomura and Abe (2011); to purchasing policies and procurement to espouse the values of sustainability has been advocated by Sanusi et al. (2011); and a tool kit for greening campuses has been prepared by Osmond et al. (2013).

In Australia, initial studies focused on the underpinning that sustainability is essentially an ongoing learning process involving a range of actors and a rapid shift away from current paradigms of thinking and solving. Sterling (2004) argues for both 'designed and attendant learning', where student learning, i.e. '*designed learning*', as a result of curricula and pedagogy is supported by learning within the wider community including senior management, academics and support staff i.e. '*attendant learning*' Tilbury et al. (Tilbury and Cooke 2005, Tilbury and Mulà 2009) focused on the relationship between education 'about' and 'for' sustainability. Critical thinking and reflection were encouraged alongside identifying and challenging core assumptions of staff, students and the researchers' understandings of *what is sustainability*. It focused not purely on knowledge creation, but ensuring there is action and change, thus changing traditional forms of knowledge generation to transmission of knowledge. Lyth et al. (2007) highlighted a range of professional support for built environment professionals including professional education on climate change adaptation and mitigation and a continuous process of monitoring and feedback.

Despite the evidence for making fundamental changes very little has been practically achieved. Taleghani et al. (2011) note that in the architecture curriculum, most schools that engage in sustainability debate treat it as a fringe issue. Professionals in the sector generally understand the need to address sustainability issues in the built environment, but not its practical implications (Snow and Prasad 2011).

In the regulatory sector, building codes and associated mandatory and voluntary building performance rating tools address "greening" in the residential and non-residential sectors. In the non-residential sector, over 5,700,000 m^2 of commercial spaces have been rated by the Green Building Council in Australia (GBCA), a not for profit organisation established in 2003 to promote green buildings. The rating scheme developed by the GBCA, Green Star, commenced with applications in the non-residential sector and initially focused on the design intent to reduce overall greenhouse gas emissions. It was only in 2014, that the gap between design intent and actual building performance narrowed. This is not unique to Australia, other countries have traversed a similar path.

From 2010, a number of more sustainable university buildings were designed and built across Australia, spurred by a pilot rating scheme for educational

buildings by the GBCA. RMIT University become a sponsor of the education rating tool.

The following sections provide an overview of RMIT University and details of the research project.

2 RMIT University

RMIT University is Australia's largest dual sector tertiary institution. It offers an extensive range of postgraduate, undergraduate and vocational programs in Australia and regionally across the Asia Pacific, Europe and Latin America. In recent QS (Quacquarelli Symonds) rankings, RMIT scored 33 in design, urban planning and building.

RMIT is committed to sustainability across teaching, research, and operational activities and has made a commitment to reduce direct greenhouse gas emissions by 25 % by 2020, based on 2007 baseline. RMIT University strives to ensure that all university graduates are environmentally literate, and have the awareness and understanding to be ecologically responsible citizens.

2.1 The Idea

It is within this background that this project—Urban Learning Lab (ULL): learning from Swanston Academic Building (SAB) was developed and implemented. RMIT University has a number of innovative new buildings, which have been designed to deliver exemplary sustainability outcomes, and enhanced teaching and learning experiences for staff and students. These buildings are an international exemplar showcasing sustainability outcomes and integrating sustainability into the university curriculum via the use of buildings/infrastructure as Urban Living and Learning Labs.

The ULL project was developed by researchers in consultation with the department responsible (Property Services) for building and maintaining property assets at RMIT. The aim of the project was to use the learnings from research to develop a comprehensive case study of the SAB to maximize future Triple Bottom Line (TBL) opportunities for RMIT as an educational institution for teaching and learning, and as an owner/occupier of institutional buildings.

To address this aim, a Post Occupancy Evaluation (POE), in addition to exploring the overall planning, construction and occupation with key building stakeholders was undertaken. Further the ULL also used (and continues to use) SAB as a living case study for students to collect further POE data, and analyse the performance of SAB against design targets and International Green Building standards, so that real life experience and problem based learning was brought into the classroom, opportunities for integrating sustainability principles and practices maximised, opportunities for providing more courses maximised, professional development opportunities maximised and forging links and partnerships with industry were nurtured.

2.2 Swanston Academic Building (SAB) Case Study

SAB is a 12 level, 35,000 m^2 innovative state of the art learning and teaching facility designed for 6000 students with office space to accommodate 850 staff at RMIT University. It was the largest capital expenditure in the university's history ($182 million) when completed in 2012.

Some key highlights of the building and process include:

- Engaging future generation of teaching, learning and students,
- Creating significant common area student portals for a vertical campus,
- Relocating students and staff from an external location to the main campus,
- Achieving a 5 star Green Star design rating,
- Using a design and construct guaranteed maximum price contract,
- Building completion achieved 108 days ahead of schedule,
- Delivered under budget ($3.4 million),
- Innovative IT development across the university, and the southern hemisphere, and
- Innovative design (including natural ventilation in parts) and materials (e.g. façade).

3 Method

The research utilised a mixed methods approach to evaluate all parts of the design, construction and occupation phases of the SAB. This was undertaken through two main methods: a Post Occupancy Evaluation (POE) and stakeholder interviews.

3.1 Post Occupancy Evaluation (POE)

The POE involved analysis from the building of utility consumption (electricity, gas and water) from the occupation of the building in August 2012 to December 2014. This data was collected from the SAB's Building Management System (BMS) and the data was cross-checked with billing data for accuracy. This utility data was compared to initial Green Star design utility performance aspirations as determined by the GBCA in the educational design rating tool and the wider RMIT City Campus building stock to assess the performance of the building. RMIT Property Services provided utility data for other RMIT City Campus buildings. Property Services also provided a room-by-room breakdown of occupancy and utilisation rates for the SAB and other campus buildings.

Internal temperature data from set points within the SAB was collected both through the BMS and the use of the research teams own Hobo temperature and humidity data loggers, again acting both as a data check and to improve accuracy. Temperature data was recorded on a 15 min frequency and informed overall

occupant comfort in the building as well as thermal performance against the Green Star design. The collection and analysis of utility performance data, occupation/utilisation rates and temperature data followed techniques, which have been applied across building research internationally (e.g. Ridley et al. 2013). This allows for comparison of results to the increasing emergence of evaluations of academic and other sustainable buildings.

In addition, an occupant satisfaction survey was conducted for staff and higher degree by research (HDR) students located in the SAB in March 2014. The survey applied the international standardised Building User Satisfaction (BUS) survey developed in the UK by Leaman and Bordass (1999, 2001) and licenced to ARUP Consulting in Australia. The BUS is internationally recognised, with over 30 years of use, and allows the performance of the case study to be benchmarked against an international buildings database. The BUS has been applied in numerous research projects across the world for both residential and non-residential buildings. The three page survey takes approximately 10 min to compete with sections on thermal comfort, noise, air quality, space and general amenities. Questions include both closed and open ended questions. The survey was distributed to all staff in the SAB via email from management of the School located in the building, and then followed up one month later with a paper based reminder. The response for the BUS survey was 150 out of 689 staff and full time HDR students, a response rate of 20 %. Data from the survey was also cross-checked with the performance analysis and stakeholder interviews to triangulate outcomes.

3.2 Stakeholder Interviews

Semi-structured interviews were conducted with 17 key internal and external stakeholders who were involved throughout the design, construction and/or occupation of the building. The external stakeholders included the architect, Environmentally Sustainable Design (ESD) engineer, builder, project manager and building facilities manager. Internal stakeholders included senior managers, advisors, directors and student representatives from within Property Services and from the School which predominantly occupies the building.

Interviews were undertaken from April 2014 to February 2015 and were conducted at the interviewee's place of work or at the university. Interviews lasted an hour. Stakeholders were identified by Property Services as key people who had been, or continued to be, involved in the SAB project. Questions related to what the participants thought worked well on the project, what were the challenges, and what were the lessons for future projects around three broad interview themes: initial impressions, processes and governance and specifics of the building. The interviews were audio recorded and transcribed. Semi-structured interviews were undertaken so that a detailed understanding of the above themes was possible. In particular they allowed for covering contextual situations and following up interesting elements

with further questioning. Care was taken to reduce weaknesses of interviews such as interviewer bias, through techniques such as repeating key questions in different ways throughout the interview to allow answers to be correlated.

3.3 Student Projects

Lastly, as part of developing the ULL, a number of undergraduate courses engaged students to undertake small research projects within, and on, the building and occupants. These projects included further investigation of building performance and occupant satisfaction surveys from the student perspective. These student projects are not reported on in this chapter.

4 Analysis and Discussion

4.1 Post Occupancy Evaluation (POE)

The analysis found that the actual energy usage of SAB was higher than Green Star and internal design performance targets, but is lower than comparable RMIT University campus buildings (Fig. 1). The SAB was found to have a significantly higher occupancy rate than predicted. When the energy data is analysed for a kWh/m^2/occupant, the building is found to be 98 % lower than comparable buildings within the university. Even if occupancy levels were assumed to be at similar level to other buildings, the improved energy performance is 50 %.

Fig. 1 Comparison of actual and target/predicted energy performance

However, in terms of overall greenhouse gas emissions, the building is performing at 3.5 times higher than the predicted rate. Part of this is due to the higher utilisation of the building. The higher utilisation rate has largely been attributed to the attractiveness of spaces to work in, particularly from the undergraduate student perspective.

The building was found to have excellent water consumption. Factoring in for floor area, the building was found to have 61 % lower water consumption to other RMIT buildings. When rainwater and recycled water is considered, actual potable water consumption of the building was 92 % lower than comparable RMIT buildings.

Temperatures in the monitored teaching and student portal spaces were found to be within the required comfort range (18–26 °C) 97 % of the time. The use of natural ventilation in parts of the building was deemed successful and temperature settings for the building have been revised to reflect occupants accepting higher/lower internal temperatures in summer and winter periods.

Occupant satisfaction with the building is high with satisfaction levels in the 64 % top percentile compared to an Australian benchmark. The improved environmental performance has not been achieved as a result of sacrificing occupant satisfaction. The main findings of the BUS survey are summarised in Fig. 2, and were:

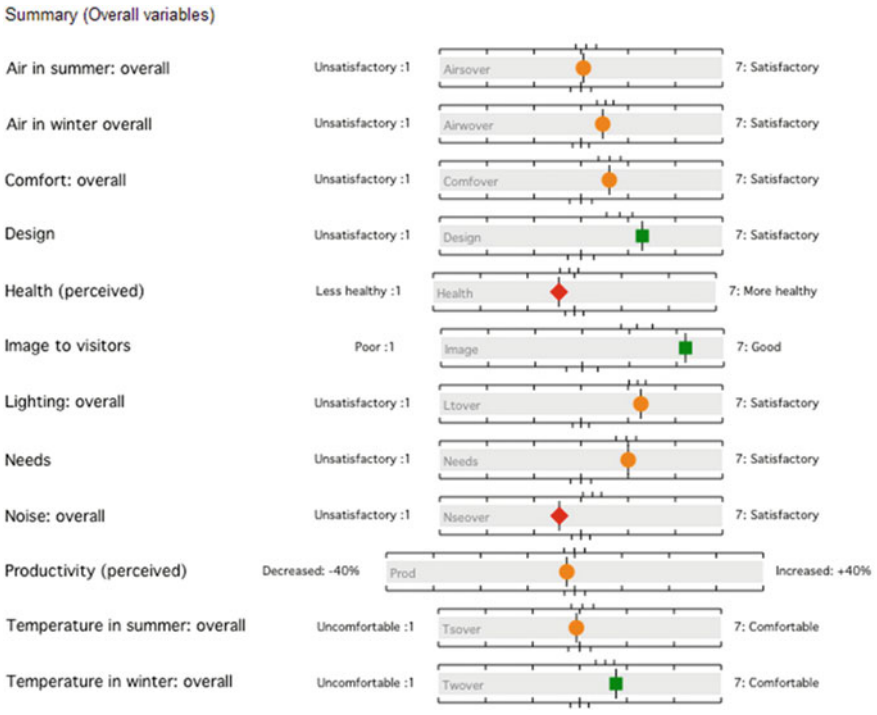

Fig. 2 Summary of main BUS findings

- The building performed excellently in three categories: Overall comfort, design and image to visitors. This may be attributed to the abundance of natural light and thermal comfort settings. For staff and students, there are plenty of spaces where people can meet informally, in addition, to the formal meeting spaces.
- The building performed poorly in two categories: Perceived health and overall noise. Staff and HDR students moved from a building where they had individual offices. In the new accommodation provided at the SAB, only those staff members who were above a certain position were provided individual offices. This contributed to their satisfactory rates in relation to noise. In relation to health, the response reflected occupants' views as to whether the design and comfort of the building space supported their overall health.

4.2 Interviews

The interviews with key stakeholders found a number of challenges, successes and learnings—a summary of key outcomes are presented below.

Critical to the success of the project was the exemplary working relationship between the external stakeholders. These stakeholders had worked together previously and knew how each other operated. The external stakeholders were critical of the engagement at times from the university, however senior personnel from the university felt comfortable that they had in place a governance structure which allowed for input into the design and construction at the required points in time.

> When the relationships aren't there and the architect and the other consultants are banging heads…that is when for us as a [stakeholder] it is difficult…on this project that wasn't the case – they all worked well together.

Another upfront decision, which impacted on the entire project was the decision by the university to undertake the project through a maximum price design and construct contract which was not common within the academic sector at the time. The practical outcome of this was that the design phase was extended by an additional six months at the request of the architect. The university was happy to allow this as there was no impact on the overall project costs due to the contract. The additional design time was used to properly consider, test and design the building.

Specifically it allowed time for one of the most innovative elements not just from the development but across the university sector in Australia at that time: the development of a virtual time table to test out various room and space requirements and occupancy predictions for the new building, not just for the present but to meet the needs of students and staff in a rapidly changing environment into the future. Through the use of the virtual time table, 10 % of internal floor space was saved, resulting in tangible economic savings for the university. The use of virtual time

tabling is now common across Australian Universities after the benefits were demonstrated through this development.

The detail and time spent during this phase of the project was identified as a key reason why the project was able to be completed 6 months earlier than scheduled; although finishing early meant there were a range of other issues which arose such as not enough time to commission the building and test the IT network. This was because in the race to get the building completed on time, the university did not pay attention to commissioning and indeed, address the need for skilled staff to be involved in commissioning the building. As a result, the building manager was appointed on a contract. This person was one of the stakeholders interviewed and highlighted a number of issues that needed to be rectified as part of the commissioning process.

The external stakeholders stated that a key difference in this project was the buy-in from senior management at the university—and that this buy-in then flowed down across all involved in the project. Despite this, there were challenges throughout the project to engage staff to participate in the project and prepare for moving into the building, especially as the building was promoting cultural change.

> It's good to allow people the opportunity to comment and 'allow buy-in…especially when you are using architecture to drive cultural change, which this building is doing.

The preparation of staff who were to move into the building for the cultural change was one area where key learnings were identified. The interviews identified that this transition process became an internally championed process from within the School moving into the building. This was in recognition that there seemed to be no clear approach to preparing staff from the project management team; although the project management team disputed this to some degree stating they allocated resources and developed a pathway to facilitate the transition.

Two years of occupation in the building has highlighted that the building is very well used, by both staff and students, with the latter occupying the building beyond anticipated/expected periods. While not all the innovative teaching spaces and elements are successful, the majority of them are, and this is a testament to the success of the building. There has been ongoing refinement for learning exactly what types of classes the various spaces are best suited to and how to best operate the building. Recognition from both internal and external stakeholders was that while the teaching and student areas were well designed and utilised, more focus should have been applied to the staff areas, which were identified as a bit disappointing.

> The utilisation stats from last year was 20% more attendance in the classes in the building than the rest of the university.

While there were a number of key learnings from the project, there was no central repository of knowledge where learnings such as those explored above could be documented and used to inform future developments at the university. It was left up to individual staff members to take on this task, leaving the university vulnerable to loss of valuable Intellectual Property (IP) with staff turnover. Many of

the external stakeholders had applied the learnings from the project to their next project, so the IP generated through the design and execution of the SAB has already provided some informal learning outcomes.

This project has shown that amongst the various criteria for success, there is need to:

- Ensure top-down buy-in from all levels of management at the university for ensuring that goals for sustainable outcomes are aligned with the occupiers of the building, the functional needs of the building and the stakeholder management team.
- Nurture working relationships between external stakeholders, again ensuring that goals for sustainable outcomes are aligned, both in terms of process, practice and performance of the building.
- Engage the various internal stakeholder groups in the process as early as possible with open and transparent communication. Support needs to be provided for building occupiers to ensure that they understand not just the sustainability underpinnings of the building itself, but also how the building is to be operated so that they can play an active role in the operation of the building.
- Allow sufficient time for a detailed design phase, so that the full impact of design decisions are considered.
- Include an as-built rating requirement (i.e. performance), not just a design requirement. This will enable alignment between the actual performance, as determined by utility data of the building with understanding the full impact of the design decisions.
- Allow adequate resources to prepare staff for cultural transition. This will ensure that performance measures can be aligned with the role played by occupiers of the building.
- Have a more formalized pre and post development evaluation, including a strategy for adoption of lessons learned. This will ensure that the learnings can be applied to similar types of buildings or situations in the future.
- Address disconnect between predicted and actual building performance. Predicted building performance is usually undertaken through modeling at the design phase of the building, using a set of assumptions.

4.3 Limitations of the Study

Evidence that a single building can improve future outcomes for a university is presented. Despite the detailed data collection and analysis, the focus of the research is only the one building. Therefore, while generalisations are limited to this one building, the research does have broad significance and learnings for the future development of academic and other buildings both in Australia and internationally. The outcomes of the research can be applied to other buildings, therefore, the opportunity and potential to improve broader built environment outcomes is clearly

possible. Also, the staff in the SAB had been involved with ongoing professional development and various evaluations during the design, construction and early occupation of the building—therefore it was not surprising that the survey response rate was not higher, as there was a feeling of evaluation fatigue amongst occupants.

5 Conclusions

Universities around the world have an obligation to actively participate in the transition to an environmentally sustainable future. However while progress is being made across a range of elements (e.g. energy efficiency), there is a lack of holistic evaluation of this progress. This chapter has presented an evaluation of a new innovative and sustainable academic building in Australia. The results found that the chosen building is performing significantly better than comparable RMIT university buildings as far as function, utilisation and thermal comfort are considered. However, there is a disconnect between the assumptions underpinning the predicted performance of the GBCA educational design rating tool used in the design stage and actual performance outcomes of the building post construction. Higher than expected building utility performance was found and the suitability of the tool to reflect real word outcomes requires further investigation across the broader academic sector to improve modelling outcomes. The BUS survey found that occupant satisfaction with the building is high with satisfaction levels in the 64 % top percentile compared to the Australian benchmark. The improved environmental performance has not been achieved as a result of sacrificing occupant satisfaction.

The interviews with the stakeholders found that there were a number of factors that worked well during the development. Allowing sufficient time for design and innovation, situating and aligning environmental performance as a key design outcome and improving stakeholder engagement and communication throughout the entire project were successful. However, there were improvements, which could be integrated into future projects around governance, communication to staff and students and design outcomes. There is evidence that some of these learnings have been taken into new developments from the university but further progress can be made.

These findings are applicable not only to the wider university sector but the built environment, both in Australia and internationally, for example the integration of sustainability outcomes into the design brief, rather than being treated as an 'add on' requirement. As more buildings, academic or otherwise, undergo evaluation of processes, performance and outcomes, data and learnings can be fed back into the design tools to help improve the performance.

It is clear that evaluations of academic buildings have a role to play to improve sustainability outcomes and improve integration of sustainability into teaching, learning, research and university governance. Furthermore, the method of holistic building evaluation undertaken in this project should be included into all major

building projects around the world, so that owners, occupants and built environment stakeholders can continue to improve the sustainability and useability of buildings.

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Science-Society Interfaces—Transforming Universities

Katarzyna Gruszka and Christian Rammel

Abstract

With the current imperatives around social justice and ecological disruption, the key challenge can be seen in the question of how to achieve vital changes, not whether. This question spills into a range of areas, and in an educational setting refers also to motivating stakeholders for engaging in sustainable change. The prospects of profound changes are more and more often discussed in terms of bottom-up social, cultural and institutional transformations, rather than top-down structured (technological) transitions. Crucially, the question of unsustainability is systemic, i.e. interwoven with our broadly understood socio-economic structures, beliefs, everyday decision and practices, to name just a few pieces of the puzzle. In tracking the roots of the current challenges, universities seem particularly relevant in terms of their transformative potential as they shape societal development via outreach and educating future generations. Seeing higher education among the major driving forces for transformations, we focus on transformative universities and their role in providing science-society interfaces and further supporting related participation processes. We highlight the difference between a transitory and a transformative approach to sustainable higher education. Herein, we devote special attention to university-based Regional Centres of Expertise on Education for Sustainable Development (RCEs), which we describe as learning communities encouraging different actors to explore change. Referring to transformative education, we emphasize the

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potential of RCEs to foster more sustainability-oriented pedagogic approaches such as experienced based learning and service learning.

Keywords
Transformation · Transition · ESD · Transformative universities · Transformative education · Science-society interface

1 Introduction

The severity of the ecological, economic and social crises that we are currently experiencing is broadly recognized. These multiple crises (Haberl et al. 2011; Brand et al. 2013; Leach et al. 2013; Scoones et al. 2015) are characterized by a myriad of issues such as growing inequality, austerity measures, biodiversity loss and mass extinction, to name just a few (see e.g. Raworth 2012; Steffen et al. 2015). Curiously, the nexus of environmental threats has been much more successful in drawing the attention of global governance than the older narratives of poverty and inequality, for example (Stirling 2015). Still, in this atmosphere of urgency, the role of political and other institutions and their abilities to contain crises comes to light and is being challenged (Scoones et al. 2015). As Stirling (2015) rightly points out, in light of such troubling realities, the key question is not whether changes are necessary, but rather how the necessary changes can be stimulated and achieved. However, debates on change are more often than not dominated by incremental tinkering of the status quo, rather than an overhaul system redesign and transformation (Naidoo 2014). The focus only on individual behaviour rather than the existing structures and powerful interests behind them as the core root of environmental degradation (Stirling 2014) is an example of a misreading of this systemic character.

This imperative of change is also deeply reflected in the area of education, as higher education institutions (HEI) are seen as major drivers in the process (Scott et al. 2012; Disterheft et al. 2013). To fulfil this transformative role, HEI need to transform themselves (Mader et al. 2013) and change their central functions and ways of interaction with the world outside of classrooms (Lozano 2006). Usually, such interactions with the "non-academic world" are restrained by a top-down approach focusing exclusively on knowledge transfer and incremental change rather than on a participatory dialogue between different domains of knowledge, interests and value systems (Sneddon et al. 2006). Consequently, the transformative process is neither driven by the necessary integration of stakeholders inside and outside HEI, nor supportive in region-specific sustainability challenges. Facing these current limitations to the transformative power of HEI, our purpose is to provide an outline of how sustainable change processes can be conceptualized and realised in the context of HEI.

In this chapter, we first look into how change is talked about in terms of transition and transformation. Therein, we aim to emphasize the implications that these two discourses have for the involved interests and actors. Importantly, the concept of transformation, borrowed from political setting, is applied to a broader context of change towards "a more just and sustainable society" (Brand and Daiber 2012: 4). Having prepared the conceptual grounds, we move on to the educational realm to apply the outlined transition/transformation considerations to HEIs. The promise of transformative potential of HEIs can be fulfilled in manifold ways. We devote special attention to university-based Regional Centers of Expertise on Education for Sustainable Development (RCEs). These science-society interfaces hold the potential to foster transformation via developing and integrating sustainability-oriented pedagogical approaches and enhancing the engagement of stakeholders in education fur sustainable development (ESD). We conclude with a discussion and point to possible further areas within the topic in need of investigation.

2 Discourses of Change

The question of how the essential technological, political, economic and cultural changes can be achieved has opened manifold debates on conceptualizations of change processes, with what can be called transitional and transformational thinking at the core. In considerations of change, particularly in terms of sustainability, this 'general heuristic distinction' into transition and transformation has been largely discussed by Stirling (2011, 2014, 2015). Within the context of scientific framings of growing environmental threats and various forms of insecurity and injustice, Stirling points to the generally stronger recognition of the need for change. Still, he remarks on the predominance of authoritarian apocalyptic discourses locating individual behaviour at the core of the issues, and reinforcing the belief in managing such behaviour as *the* solution. He explores practical implications of transition and transformation as two understandings of change. In what follows, we sum up the line of argumentation behind the distinction, preparing the ground for moving to the educational realm.

In the case of transitions, a given change process takes place in an atmosphere of structured control and management, frequently with technological innovation as key driver. This control and management often lies within the hands of the incumbent structures and actors, feeding into the existing distribution of power (Stirling 2014, 2015). The support of incumbent interests is often enabled through governmental funding (Shove and Walker 2007), while the less-concentrated initiatives of citizens, consumers and civil society fall into neglect (Seyfang and Smith 2007). Thus, the questions of power and diversity are downplayed. For example, in transitional thinking diversity is not necessarily understood as a source of creativity. Rather, reducing it is often seen as necessary, as "strong incentives push for 'integrated' frameworks, justifying 'complete' interpretations, 'definitive' explanations or 'robust' prescriptions" (Stirling 2011). Moreover, in such framing,

uncertainty tends to be pushed away from the picture, mainly by the preference for deterministic understandings that inform evidence-based policy (ibid.). This illusion of control becomes particularly problematic in the face of global climate issues, where values such as humility and responsibility for the human activity and its consequences give way to a quest for presumed static idealised optimum (Stirling 2014).

Such an approach finds its expression in sustainability transitions literature, particularly in Transition Management (TM). A transition is defined as "a fundamental change in the structures, cultures and practices of a societal system, (…) altering the way it functions" (de Haan and Rotmans 2011: 90–91). These marked changes have been researched primarily within socio-technical systems, focusing on the infrastructures of provision and supply, and resting on a co-evolutionary view of technology and society (Rip and Kemp 1998; Geels 2004, 2012). Since the late 1990s, the term has been conjoined with the concept of normative changes towards sustainability (Markard et al. 2012). TM uses a model that operates according to principles developed with policy makers (Kemp 2010), and introduces a four-level structure. The strategic level is where societal problems are restructured towards reaching a joint agenda through stimulating a social learning process among a network of front-runners. The agenda is further specified and implemented on the tactical level where system structures are built up and broken down. Actors and their every-day decisions gain importance at the operational level in transition experiment, while evaluation of a given transition process and possible adjustments happen at the reflexive level (Kemp et al. 2007; Loorbach and Rotmans 2010). Sustainability transitions and TM in particular, reinforce the technological fix, and embody the incumbent-dominated managerial approach. Diversity is theoretically recognized, yet practically stifled. While not denying the merit of a great body of knowledge generated by transition research, such practices often lead to only minor changes to the existing situation or "tweaking the system" (Stirling 2015).

Transformations, to the contrary, broaden the understanding of change through embracing both social and technological innovations (Seyfang and Haxeltine 2012). The incumbent structures and actors are challenged by a diversity of 'emergent and unruly political re-alignments' in change processes driven by a plurality of divergent knowledges. Plurality, along with contention and struggle, appear to be the key word, and is also reflected in pursuing non-deterministic, contending, often unknown ends. Existing rules and values, along with related power implications, are called into question (Fischer-Kowalski and Hausknost 2014; Stirling 2014, 2015). Values here refer to a range of virtues and social qualities rather than utilitarian seeking of prescribed goals. Control gives way to mutual care in high appreciation of diversity and democracy. As such, transformation emphasizes the role of civil society and social movements voicing alternate interests (Seyfang and Smith 2007), and values complex and deeply plural 'culturing' of a given change process. Bottom-up activities, therefore, are put to the fore as the source of more profound changes than orchestrated top-down transitions.

To illustrate this framing, Stirling lists a number of examples, e.g. within food production and use as expressed in ecological farming, local supply chains, or intensification of collective ownership (2014, 2015). These changes in culture and practice in the sector reflect diverse knowledges and bring non-incumbent interests to light, thereby coming closer to transformation rather than transition. Also, sustainability itself is seen as a concept that entered the global agenda via a plurality of contested voices, rather than apolitical procedures (Stirling 2015). Fitting examples can be found among certain practices of sharing or collaborative economy i.e. digital platforms and offline activities ranging from recirculation of goods, increased utilization of durable assets, exchange of services, and sharing of productive assets (Schor 2014). Sharing economy activities can be peer-to-peer or business-to-peer, with both non-profit and for-profit orientation. Starting from the definitional fuzziness, the concept is suffering from an array of issues. The questions of profit-maximization and the introduction of venture capital, the "corporatization of a number of the leading players" (ibid.: 2), can be given as an example. Such developments are often claimed to disturb the visionary picture of societies that are fairer, more sustainable, and more socially connected, drawn by key supporters. Leaving the debates aside, transformative potential could lie in e.g. the proliferation of maker spaces, skill-sharing platforms, as well as initiatives such as Peer-to-Peer University as attempts of democratizing access to education and enabling more peer teaching. Importantly, both for- and non-profit organizations are in an urgent need of redefining legal structures in terms of ownership and labour regulations (Orsi 2013)—a need that is put on the agenda thanks to the plural voices of this non-unified movement. Thereby lay certain aspects of transformative thinking. The broader impact of the concept, in line with Schor (2014), will depend on further developments once the current critical juncture the concept found itself in is passed. One might imagine that such a juncture functions as a scene where the ideas behind transition and transformation play a major role.

Finally, Stirling's distinction is not to be taken as a clear-cut dichotomy. Rather, the point, as the author himself puts it, is that:

> if the distinction is not made (by whatever names), then governance knowledges and discourses (as well as practices) in any given sector are vulnerable to systematic subversion by incumbent interests to channel more around expediently controlled transition than inconveniently emergent transformation (Stirling 2015: 62).

Keeping this in mind let us move on to the educational realm and consider the role of HEIs in change processes.

3 Knowledge and Change

3.1 Transformative Universities

HEIs have a significant role in promoting sustainability and contributing to a paradigm shift towards a more sustainable future. A growing number of

international treaties and policy statements underline that universities are bound to transform prevailing epistemic assumptions (Disterheft et al. 2013; Fadeeva et al. 2014). Universities represent important vehicles to explore, test, develop, and communicate the context-specific conditions for sustainable change (Rammel et al. 2015). HEIs have the capacity to enhance sustainable change as they educate future generations (UNESCO 2004). At first glance, this focus on transformative universities seems to be based on international consensus. Nevertheless, a closer look reveals two approaches on the role of HEIs for sustainable development.

The first is rooted in the classic understanding of universities. Here, the main purpose of universities is to generate reliable scientific knowledge and to educate scientific experts whose goals are to tackle societal challenges (Fadeeva 2007). This perspective assumes a compartmentalisation of society and separates people and institutions into experts (producing knowledge) and non-experts (receiving knowledge). When facing current sustainability challenges, the primary role of scientists is to provide solutions to concrete problems such as climate change, unemployment or food insecurity. Herein, disciplines are of crucial importance. This disciplinary compartmentalisation isolates specific realms of concern and excludes potential interactions and co-creation of knowledge (Gibbons 1999; Moulaert et al. 2013). This approach is characterised by incremental change and improvement along current paths rather than paradigmatic change. It reduces higher education and scientific reasoning to "doing things better", meaning in a more efficient way, but without necessarily questioning the purpose, which in contrast would lead to "doing better things" (Sterling 2010). Such an understanding of scientific knowledge with its focus on expert-induced and expert-controlled change can be seen as a reflection of the transition approach explained in the previous section. It excludes not only the different perspectives and activities of non-academic stakeholders, but also different university stakeholders who are not in the position to provide official policy recommendations. The often stated whole-institution approach, which is seen as a basic requirement for ESD at HEIs (UNECE 2005) does not stop at the boundaries of the campus. Whole-institution means also that the university as a whole, with its stakeholders, must be seen as embedded within a concrete local, regional and international sustainability context.

Emphasis on expert knowledge has limited capacity to induce real change, since it rests on improvement of the status quo rather than on a paradigmatic shift in the ways we learn, teach, and do research. This has provoked increasing criticism over the last years, and opened up a new perspective on transformative universities (Crow 2007; Miller et al. 2011). Pathways towards a more sustainable future do not rely on more knowledge transferred by scientific experts (Orr 2004). Sustainable development is driven by values, participation and social learning. Ideally, it represents a dialogue between different domains of knowledge and interests, and cannot be reduced to the problem of insufficient knowledge (Sneddon et al. 2006; UNESCO 2006). To open this dialogue, universities need to recognize and combine the multiple ways and domains of knowledge (epistemological pluralism) as well as

integrate the variety of perspectives, knowledge systems and values (reflexivity) (Miller et al. 2011). This demand for epistemological pluralism and reflexivity is in line with the need for bottom-up social, cultural and institutional transformations. It goes hand in hand with a strong focus on engaging university stakeholders in ESD. In contrast to what we would call transitory approach to universities, which enables a few experts from selected disciplines to transfer their knowledge and influence policy making, transformational approach calls for active participation across the boundaries of HEIs and across internal hierarchies. The latter opens new fields of engagement for both university-based and outsider stakeholders.

3.2 Transformative Education in Higher Education

The ability to teach, motivate and enable students as agents of change is reflected at universities through epistemological pluralism, reflexivity and a general transformative focus as structural and integrative elements. Enhancing the transformative abilities of students displaces the current stress on knowledge acquisition and cognitive engagement. Rather, it fosters capabilities such as interdisciplinary thinking, teamwork and reflexivity, and supports values, behaviours, and activities that enable sustainable development (Hicks 2002; Sipos et al. 2008). However, before universities can unfold their transformative capacity as well as the transformative capacity of their students, they need to transform themselves (Mader et al. 2013). The consequences of this transformational process are enormous, the implications for the daily life of universities most radical (Lozano 2006; Thomas 2009). This reorientation of universities is characterised by a broader understanding of learning processes and a subsequent bridging between learning and doing, but most of all it is a reorientation towards transformative education.

Transformative education can be described as an educational framework providing open learning processes for initiating a structural shift in the basic conditions of thoughts, feelings and actions. This approach to teaching and learning includes cognitive, emotional and activity-oriented aspects and attempts to facilitate the recognition of our worldviews while enabling paradigmatic reconstruction (Sipos et al. 2008; Sterling 2010; Thomas 2009). The linkages between transformative education, sustainability and education for sustainable development (ESD) were emphasized by authors such as Lange (2012) or Tilbury (2004). Especially the implementation of ESD key principles in HEIs expresses a radical shift from a traditional concept of education towards a stronger transformative view of pedagogy and participatory learning for change (Sterling 2010). Bridging transformative education with ESD calls for participatory learning environment that supports an open dialogue between different disciplines and stakeholders outside the academic community. Transformative teaching and learning unfolds across a transdisciplinary setting and aims at experiences outside the classroom, thereby enhancing the engagement of students, teachers and researchers in ESD Hence, we stress the importance of institutionalized science-society interfaces at universities.

3.3 Science-Society Interface: Regional Centres of Education for Sustainable Development

Broadly speaking, science-society interfaces provide an institutional and transdisciplinary setting for teaching and learning. They enable collaborations between different actors, including scientists, enterprises, NGOs, city administrators, communities or educational institutions. Global examples for science-society interfaces are the more than 130 Regional Centres of Expertise on Education for Sustainable Development (RCEs), based on an international initiative to implement the goals of the UN Decade of Education for Sustainable Development (2005–2014). As regional networks certified by the United Nations University (UNU), RCEs promote ESD through formal, non-formal and informal education and offer regional platforms for learning, stakeholder engagement and alliances for sustainable development. An RCE can be understood as a learning community, which encourages different societal actors to explore epistemic change and transformations as a collaborative inquiry. RCEs share the fundamental idea of epistemological pluralism and reflexivity, recognizing that in questions of sustainability there is no sufficient intellectual authority of single forms of knowledge (Fadeeva 2007).

RCEs provide many cases for pioneer work in the area of changing the curricula towards transformative teaching and learning (Mochizuki and Fadeeva 2008; UNU-IAS 2014). As transformative learning processes are driven by personal engagement and stimulate a critical reflection on experience (Taylor 2007), RCEs can offer a setting of real-life learning through interactions with various stakeholders, and integrate regional challenges of sustainability into the curricula, therefore opening possibilities for trandisciplinary learning. For involved citizens from outside the university, participation in such transdisciplinary learning processes provides an arena for popularizing their concerns and supports their engagement in change (Novy et al. 2013).

Putting an emphasis on co-development of knowledge for sustainability at the very heart of the learning process, RCEs support the development of more sustainability-oriented pedagogic approaches such as experienced-based learning. Experience-based learning motivates the learners to analyse their experience by reflecting, evaluating and reconstructing it (Andresen et al. 2000; Lester et al. 2005). For RCEs, experienced-based learning is of special interest as it embodies ESD principles and acknowledges real-life problems for developing necessary capacities (Barth et al. 2014). One of the examples of experience-based learning is service learning (SL). SL reflects an alternative teaching approach where students are confronted with specific regional problems and try to find solutions in cooperation with different stakeholders (Stuteville and Ikerd 2009). SL focuses on participatory learning and giving service to the community, and increases the engagement of students in regional ESD processes. At the same time, it fosters knowledge exchange between science and society and supports the focus on

regional and local challenges. SL requires the faculty to reconsider expert-controlled change and linear knowledge transfer. Its transformative character is also highlighted by its ability to engage learners in regional sustainability problems as active citizens via building both factual knowledge ("knowing-that") and procedural knowledge ("knowing-how") (Barth et al. 2014).

4 Perspectives and Concluding Remarks

Heading towards the end of our considerations, we stress yet again that in the current context of the myriad of ecological and social injustice, it is no longer the question of *whether* to change, but rather *how* to do it. Within educational realm, this question extends also into searching for ways of increasing the engagement of diverse stakeholder groups in the processes of sustainable change. As discussed, rendering answers to the *how* question can possibly start from drawing a heuristic distinction between the concepts of transition and transformation.

Taking the discussion to the area of HEIs enables us to see certain linkages corresponding to the above distinction and helps us clarify the crucial role of universities as drivers of sustainable change. The classic understanding of universities as the ground for expert knowledge production, and further preaching of the knowledge to the non-expert crowd brings immediate associations with the concept of transition. Such an approach accords with the divide between the institution of universities and societies it is embedded in. Here, if change processes are at stake, they are expert-induced and expert-controlled, and knowledge is transferred in a linear manner. To the contrary, the plenitude of discussions on sustainable development that entered educational realm lead to questioning of such understanding of the role of HEIs and brought transformative universities with transformative learning to the fore. In this approach, plurality of knowledge and reflexivity that integrate various perspectives, values and knowledge systems from outside of traditionally-drawn academic boundaries are basic and enable paradigmatic change. The emphasis falls on bridging learning and doing in an environment open to non-academic voices, where diversity and uncertainty come to the fore.

Within HEIs, this openness and transdisciplinarity can be fostered by institutionalized science-society interfaces—such as RCEs—functioning as arenas of collaborative inquiries and mutual learning for a range of actors, from students, through researchers, enterprises, civic society organizations, communities and local governments. Therefore, RCEs open spaces for contending knowledge to be explored both within and outside of academic setting in order to engage in societal transformation towards a sustainable future. Importantly, even though RCEs are originally set up via the institution of the UNU, the network itself is governed in a decentralized manner, and individual RCEs are free to take action according to their own vision and focus. On a cautionary note, this freedom can be seen as a

transition/transformation junction, similarly to our example of collaborative economy.

Particularly for the issue of integrating various stakeholders of HEIs in ESD, both approaches have different implications. Expert-driven knowledge transfer characteristic of transition discourse enables a few scientists to shape science-society dialogue based on the traditional compartmentalisation between experts and non-experts. Even though the potential for shaping policies is high, the risk of the proposed changes to follow only the lines of increased efficiency and 'optimisation' of the status quo is strongly present. This approach neither reflects the plurality of knowledge systems, different values and social learning which drive sustainable development, nor does it benefit from the capacity of change and innovation brought by the nexus of teachers, researchers, students and university administration. To take another example, implementing SL can be one of the means chosen by an RCE feeding into redefining teaching and learning towards more heterogeneity and contention explored in real-life settings. However, the composition of involved non-academic stakeholders influences the quality and value of a given SL. Involving mainly incumbent companies and organizations from a specific focal area underlines the dominant and suppresses the alternate interests, and brings questions of power and control to mind. In contrast, a stronger focus on the transformative power of HEI acknowledges the high importance of a genuinely open dialogue between science and society. Such an approach calls for active participation across both the external and internal boundaries of HEIs. It fosters transdisciplinary work on concrete regional projects, hence possibly increasing stakeholder engagement for ESD.

In this chapter, we attempted to discuss different ways of conceptualizing change and the implications thereof for the HEI context. Focusing on the RCEs as institutionalized science-society interfaces, we see further necessary steps in more empirical research looking into how these different ways find their reflection in practice in terms of stakeholder engagement. This brings us back yet again to the key question of *how*—a question that members of each RCE, and HEIs, working towards (contested) transformative ends needs to consider.

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The Role of Students in the Co-creation of Transformational Knowledge and Sustainability Experiments: Experiences from Sweden, Japan and the USA

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Abstract

Accompanying realisations that engagement of multiple societal sectors (academia, industry, government, citizenry) and disciplines is required for formulating effective responses to complex sustainability challenges, calls for new forms of knowledge production are increasing in magnitude, both inside and outside the university. In parallel, experiences from the United Nations Decade of Education for Sustainable Development have highlighted that

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collaborations with societal stakeholders and experiential approaches are desirable for effective sustainability education. This article examines activities at three institutions—Lund University, Oberlin College and the University of Tokyo—to identify potential models for integrating students into the co-creation of transformational knowledge and sustainability experiments with faculty and multiple stakeholders. We examine the types of outputs that can ensue differing participation models, whilst also considering their impact on university and stakeholder efforts to advance societal sustainability. We argue that transformational sustainability partnerships integrating students can foster the alignment of the three university missions of education, research and community engagement with place-specific needs and sustainability challenges. Accordingly, efforts to promote experiential forms of sustainability education with societal stakeholders should refrain from focusing uniquely on education and encourage synergistic linking of all university missions.

Keywords
Sustainability education · University partnerships · Students · Sustainability co-creation · Stakeholder collaboration · Transformational knowledge

1 Introduction and Background

The complexity and persistent nature of sustainability challenges reflect failures in underlying, interlinked societal systems (Rotmans and Loorbach 2008). Advancing societal sustainability therefore demands strategic interventions to reconfigure dysfunctional societal systems and generate transformational knowledge (i.e. actionable as opposed to descriptive-analytical) and socio-technical innovation (Wiek et al. 2012). The assembly of knowledge, resources and expertise for this task surpasses the resources of any single player or organisation (Reeger and Bunders 2009). Consequently, there are increasing pressures and incentives for universities to move away from traditional models of discipline-centric and basic knowledge production towards implementation-focused collaborations with diverse societal stakeholders and academic disciplines. In addition to government funding calls, such expectations are becoming increasingly explicit in scientific literature and sustainability science research initiatives such as Future Earth (2013).

The concept of sustainability 'co-creation' (Mauser et al. 2013; Reeger and Bunders 2009; Trencher et al. 2013) emphasises important attributes of emerging types of university-led collaborations with multiple stakeholders to advance societal sustainability in a specific geographical location. Trencher et al. (2014b) observe that universities will often integrate various functions and engagement paradigms such as transdisciplinary research, community or regional development, real estate development, technology transfer and living laboratories etc. when engaging in the co-creation of sustainability knowledge and strategies to transform society.

Epistemologically, this process is marked by a shift from knowledge production as an end in itself, to knowledge as a means to trigger societal transformations (Van Veen et al. 2013). This reflects increasing scientific willingness to supplement the identification and analysis of sustainability challenges with joining community efforts to work on the development of practical solutions (Clark and Dickson 2003). It also mirrors earlier identified tendencies towards 'transdisciplinarity' (Klein et al. 2001; Future Earth 2013) and 'mode 2 science' (Nowotny et al. 2001) where knowledge is increasingly produced in applied settings and in response to stakeholder needs (Reeger and Bunders 2009). Sustainability co-creation therefore depicts a 'transformational mode' (Wiek et al. 2012) where codified knowledge production is complimented by implementation focused activities. In addition to economic development initiatives or inputs into public policy (Trencher et al. 2014a), this can include the joint design and implementation of sustainability experiments with stakeholders. These entail the social implementation and small-scale trial of novel technical or social arrangements in real-world settings (Berkhourt et al. 2010; Brown et al. 2003). These stretch to subsequent efforts to diffuse results with key societal actors to accelerate societal learning and progress to greater sustainability.

The co-creation of knowledge and experiments for advancing sustainability has clear relevance for Education for Sustainable Development (ESD) in universities (Wals and Corcoran 2012). First, over the last decade, the global network of Regional Centers of Expertise (RCE) has demonstrated the importance of external stakeholder collaborations for higher education and place-specific efforts to advance sustainability (Fadeeva et al. 2014). Specifically, RCEs work to increase collective knowledge and regional capacity to advance sustainable development by enhancing, on one hand, *vertical* linkages between formal learning institutions (schools and universities), and on the other, *lateral* links with societal sectors, experts and non-formal learning arenas (Fadeeva and Payyappallimana 2014). Second, the mid-term review of the Decade of Education for Sustainable Development (DESD) has uncovered widespread awareness that certain learning processes are particularly conducive to effective ESD (Tilbury 2011). These include: collaboration and dialogue (including multiple stakeholders); engagement of the 'whole system' of university functions; innovation in curricula, learning and teaching; and active and participatory learning. Needless to say, passively studying sustainability in the classroom alone is insufficient for triggering transformations in human intellect and societal structures. Alternative learning approaches are required, like those highlighted during Phase II of the DESD global monitoring and evaluation (Wals 2012, 2014). In addition to connecting education to other university functions such as research and outreach, these include trans- and inter-disciplinary learning, problem-based learning, values-based learning, experiential learning and social learning. Evidence shows that partnerships between higher education institutions and societal stakeholders for tackling local sustainability challenges can enable such learning. They can engage students across academic disciplines (Allen et al. 2014; Bacon et al. 2010) and generate opportunities for project- or problem-based

learning via real-world sustainability projects (Brundiers et al. 2010; O'Brien and Sarkis 2013; Wiek et al. 2014), experiential learning (Domask 2007) and learning from diverse societal partners, who can be key suppliers of sustainability knowledge and values to students (Jiusto et al. 2013).

Empirical evidence suggests that universities around the world are increasingly engaging in the co-creation of knowledge and solutions for various place-based sustainability related challenges (Trencher et al. 2014a, b; Zilahy and Huisingh 2009). Wals and Blewitt (2010) observe a thematic shift during 2001–2010 in articles in the *International Journal of Sustainability in Higher Education* from on-campus university operations towards increasing interest in pedagogy, community outreach and partnerships. As argued by Wals (2014), conceptions of the university as an ivory tower are increasingly challenged by the idea that it should apply its resources to addressing the needs of surrounding communities and regions. Interestingly, despite widespread examples in academia of faculty engaging with societal stakeholders in the joint production of transformational knowledge and sustainability experiments, collaborative activities with stakeholders are yet to penetrate mainstream approaches to ESD (Wals 2014). Further, despite earlier cited examples of real-world sustainability learning with external stakeholders, for the most part, these are educational programmes and not integral components of large-scale faculty research and transformational sustainability partnerships.

Guided by these literary insights, this study examines activities at three institutions—Lund University, Oberlin College and the University of Tokyo. Our principal objective is to examine potential models for integrating students into the co-creation of transformative knowledge and sustainability experiments with faculty and multiple stakeholders. We examine potential types of student contributions or outputs that may ensue from various participation avenues, also noting the societal impacts of each. By doing so, we seek to further understanding of innovative and emerging *processes* for ESD, a key area of inquiry in recent literature (Wals 2012, 2014).

2 Methods

Key characteristics of the three cases are summarised in Table 1. Several reasons underpin their selection. First, they allow representation of vastly differing approaches, institutional profiles and strengths, and also, linguistic, cultural and geographic contexts. Second, they reflect varying levels of ambition to integrate students and fuse research with education. Third, we perceive a high instructional value from their pioneering nature, ambitious objectives, and intense interventions on local communities to trigger societal transformations towards sustainability.

Data was collected principally via three means. First, authors are either directly or indirectly involved with each partnership, allowing documentation of first-hand observations and experiences. Second, data was purposively collected from various

Table 1 Overview of cases

	1. Oberlin project	2. Malmö innovation platform	3. Urban reformation program for the realisation of a bright low carbon society
Institution	Oberlin College	Lund University as a partner with Malmö University and Swedish University for Agricultural Sciences in Alnarp	University of Tokyo (Kashiwa and Hongo campus)
Institutional profile	Small, liberal arts and undergraduate college	Large, research and education intensive	Large, research intensive
Education level in participating departments	Undergraduate	Master	Master and Doctoral
Description	Partnership with the City of Oberlin to rejuvenate the entire town by transforming it into a prototype of a self-sufficient, resilient and post-fossil fuel community. Focus on implementation and efforts to trigger social transformations	Innovation and learning platform to foster innovation through socio-technical experiments to advance energy efficiency and retrofitting of existing apartment buildings. Headed by the City of Malmö, partners include Region Skåne, three universities and 16 companies	Large-scale applied research initiative to design blueprint for transition to a low-carbon, elderly citizen friendly community. Involved extensive demonstrations of technical and social innovation to aid this transformation. Key partners included the local municipality, residents, NPOs and a corporate think-tank
Target area and conditions	• Oberlin, Ohio USA • Small rural town • Challenged socio-economic conditions accompanying transition to a post-industrial economy	• Malmö, Sweden • Medium size city • Economically prosperous, yet challenged with immigration and needs to rejuvenate existing urban areas	• Kashiwa, Chiba Japan • Semi-urban satellite city to Tokyo. • Economically prosperous, yet challenged by rapidly aging population and increasing abandoned and aged buildings
Main partnership goals	• Demonstration of 'full-spectrum' sustainability at town scale • Economic development • Education	• Urban renewal • Economic development • Research • Education	• Research • Demonstration and trials of emerging technical and social innovation

(continued)

Table 1 (continued)

	1. Oberlin project	2. Malmö innovation platform	3. Urban reformation program for the realisation of a bright low carbon society
Implementation period	2010 onwards Status: On-going with no announced completion date	2013 onwards Status: on-going	2010–2015 Status: complete
Ambitions to integrate students	High. Large numbers of students involved. Multiple and explicit strategies	High. Large numbers of students involved. Multiple and explicit strategies	Medium. Relatively fewer students involved. Fewer explicit strategies
Disciplines of lead faculty	• Environmental studies • Psychology • Geology	• Environmental science • Environmental management • Environmental policy	• Engineering (mechanical, electrical, information, civil) • Urban planning • Natural environmental studies • Clinical plant science • Agriculture

semi-structured interviews and informal meetings with other faculty, researchers and societal stakeholders. Third, complimentary data came from publications such as internal reports, media articles and academic papers.

We focus our investigation on varying forms of student participation that correspond with all or most of the following criteria stressed by Rowe (2007) and Brundiers et al. (2010). That is, recurring patterns of engagement in each partnership that:

- Address a community sustainability challenge, typically defined by external stakeholders;
- Allow application of concepts and methods learnt in formal courses;
- Involve collaborative supervision from faculty and community stakeholders to ensure scientifically sound and socially robust approaches; and
- Aim to produce implementable knowledge and solutions to community challenges.

By drawing on insights from both the literature and empirical observations, our identification of various student participation avenues is therefore both inductive and deductive.

3 Overview of Cases

3.1 Oberlin Project

The Oberlin Project is a long-term partnership between Oberlin College, the City of Oberlin and various community stakeholders to revitalise and guide the town of Oberlin, Ohio (population 8300) towards post-fossil fuel prosperity, sustainability and resilience. Officially unveiled in 2010, it reflects founder David Orr's vision of 'full-spectrum sustainability' (Orr 2013) where interrelated projects join "the many strands of sustainability into an integrated response" (Orr and Cohen 2013, p. 1) to local challenges. These encompass climate change vulnerability, economic decline in the wake of a transition to a post-industrial economy, poverty and fossil fuel dependence. With research constituting a means to an end rather than an end in itself, the project is focused on implementation and triggering the following environmental, economic and societal transformations (Orr 2011):

1. Development of a 13-acre 'Green Arts District' (LEED Platinum level) comprising college facilities, a hotel, conference centre, apartments, museums and restaurants.
2. Economic revitalisation through the 'Green Arts District', new business ventures, local investment and economic development.
3. Attainment of climate positive status by 2050 through the Clinton Foundation Climate Positive Development Program (CPDP) with renewables, energy efficiency and carbon sequestration.
4. Establishment of a 20,000-acre greenbelt to supply forestry, biofuel and agricultural products, sequestration services and 70 % of food consumption by 2030.
5. Creation of a sustainability educational alliance with local schools and colleges.
6. Replication of project across the USA.

At the outset, the Oberlin Project harboured explicit educational objectives. By involving large numbers of students, it aimed to ultimately transform educational paradigms in "virtually every discipline" (Orr 2011, p. 19). Beyond formal in-classroom education, the project seeks to increase sustainability literacy through student interaction with community stakeholders, real-world situations and projects (Rosenberg Daneri et al. 2015). As framed by Jiusto et al. (2013) through the concept of 'Shared Action Learning', it views students as change agents and key suppliers of knowledge and sustainability initiatives to societal challenges. Conversely, it regards informal learning from community stakeholders and organisations as crucial for student knowledge and skill acquisition. It thus aims to "join the theoretical and practical sides of learning—head, hands, and hearts—in the remaking and revitalization of Oberlin" (Orr 2011, p. 24).

3.2 Malmö Innovation Platform

The Malmö Innovation Platform, established in 2013, unites creative forces in municipal, business, academic and community actors to collaboratively pursue innovation through the renovation of existing apartment buildings in south-east Malmö. It aims to use physical regeneration as a motor for socio-economic development and long-term environmental goals (McCormick and Kiss 2015). The partnership is coordinated by the City of Malmö in close cooperation with Lund University, Malmö University and the Swedish University for Agricultural Sciences. It includes large industry partners such as Schneider Electric, E.ON, MKB, Siemens, IBM and Skanska. The platform focuses on implementation and specifically on developing and piloting new technologies, services and innovative business concepts in existing apartment buildings. To date it has initiated 20 sustainability experiments. These range from measures such as heating system renovations to initiatives shaping tenant behaviour towards energy, water and waste.

By enabling the co-creation of social and technical innovation in real-time urban environments, the Malmö Innovation Platform functions as a 'living laboratory' (Evans and Karnoven 2010; McCormick et al. 2012). Flourishing across Sweden and Europe, living laboratories address on one hand industrial and scientific needs to engage in innovation networks, whilst on the other, expectations to further economic prosperity, social cohesion and environmental sustainability (Ryan et al. 2014). Collaborative learning is also central to living laboratories (Evans and Karvonen 2014). In Malmö, learning occurs for municipal, business, academic and community partners through joint conception, implementation and evaluation of social and technical experiments to advance the sustainability of existing apartments. Equally important, the platform was designed to generate experiential learning opportunities for students. By engaging with external partners and local situations, students can contribute research results and project ideas to stakeholders whilst simultaneously experiencing first-hand the iterative, uncertain and 'messy' reality of moving towards urban sustainability.

3.3 Urban Reformation Program for the Realisation of a Bright Low Carbon Society

This completed research programme (implemented 2010–2015) aimed to design the blueprint for a low-carbon and elderly citizen friendly reformation of the local City of Kashiwa (30 km from Tokyo and home to the University of Tokyo's third campus) by creating and demonstrating the necessary technologies and reconfigurations of social systems. It emerged in response to converging local challenges of climate change on one hand, and populating aging and shrinkage on the other (Trencher and Bai 2015). With 23 % of citizens over 65, greying trends in Japan far exceed other nations. Whilst driving a degradation of the urban environment, aging

trajectories may also hamper the economic ability to mitigate and adapt to climate change (University of Tokyo 2014).

The programme united around 40 faculty from various engineering and environmental science disciplines with external stakeholders. These included local government planners, residents, NPOs, private firms and a corporate think tank (University of Tokyo 2015). Research activities were split into six distinct groups: *energy* (development and testing of solar heating and cooling systems in buildings), *mobility* (development and trials of super compact electric vehicles and sharing infrastructure), *clinical plant science* (fostering of citizen 'plant doctors' for diagnosing and alleviating plant diseases), *agriculture and green spaces* (exploitation of local land resources for agriculture, greening and biomass production), *urban planning* (creation of urban decay policies and countermeasures), and lastly, *information systems* (creation and demonstration of supporting ICT).

A key strategy was to engage local stakeholders in the design and implementation of sustainability experiments showcasing emerging low-carbon technologies and novel social arrangements for addressing population aging and urban decline (Trencher and Bai 2015). These generated complimentary knowledge for conventional scientific research, which overall, drove the programme. Although the programme lacked explicit strategies to involve large numbers of students, activities in various groups generated opportunities for Master and Doctoral students to contribute research results and interact with community stakeholders and sustainability experiments (Trencher et al. 2015). With faculty mostly tied to steering and direction roles, much data collection, stakeholder relationship building and experiment design and implementation was performed by students.

4 Findings

4.1 Key Participation Models and Impacts

The following sections examine five student participation models found to be particularly significant across the three cases. Each is summarised in Table 2. Given the diverse and multiple forms of student participation occurring in each case, this analysis is non-exhaustive and merely highlights recurring patterns and pathways for student involvement. Acknowledging that, in practice, some of these models are complimentary and overlap, our aim is rather to highlight unique attributes and potential impacts of each.

4.1.1 Project-Based Learning

In this model the emphasis is on experiential learning and 'learning by doing', typically in teams. This occurs by the design (and sometimes implementation) of "workable contributions to solutions" (Rowe 2007 p. 324) or provision of knowledge for community challenges pre-defined by external partners (Brundiers et al. 2013; Donnelly and Fitzmaurice 2005; Wiek et al. 2014). Although also

Table 2 Key student participation models

Model	1. Project-based learning	2. Transacademic research	3. Internships	4. Project management and planning	5. Stakeholder interactions and sustainability experiments
Relevant cases	• Oberlin College • Lund University	• Oberlin College • Lund University • University of Tokyo	• Oberlin College	• Oberlin College • University of Tokyo	• Lund University • University of Tokyo • Oberlin College
Description	Student teams collaborate with faculty and external partners in formal courses to design (and often implement) workable solutions or provide bodies of knowledge for community challenges. Project needs are typically pre-defined by stakeholders	Individual students conduct research (for formal courses or graduation requirements) targeted at the local community. Stakeholders are typically involved in the knowledge production process. Results are shared with partners and stakeholders	Individual students are placed in formal work experience programmes (paid or unpaid) in local municipality, government agencies or project headquarters to allow research or project design and implementation	Through formal employment at host institution, students or graduates assume, in addition to administrative and communication tasks, management of research projects and teams, stakeholder relationship building, research, and design and implementation of various projects	Varied forms of stakeholder interactions, typically not explicitly linked to other models. May also involve design and implementation of sustainability experiments with stakeholders. May take place from inside or outside courses, and in groups or individually
Model of learning	• Group • Faculty initiated	• Individual • Student initiated	• Individual • Student and stakeholder initiated	• Individual • Faculty initiated	• Individual or group • Student or faculty initiated

(continued)

Table 2 (continued)

Model	1. Project-based learning	2. Transacademic research	3. Internships	4. Project management and planning	5. Stakeholder interactions and sustainability experiments
Principle learning environment	Classroom	Community	Community	University and community	Community
Emphasis	• Hands-on knowledge production • Project conception and implementation • Team working skills	Research and codified knowledge production	• Hands-on knowledge production • Project conception and implementation • Professional skills building	• Project and stakeholder relations management • Project conception and implementation • Research	• Knowledge acquisition and sharing • Stakeholder relationship building • Experiment conception and implementation
Potential contributions and outputs to co-creation process	Actionable or working projects and knowledge bases to address pre-defined community challenges	Quantitative and qualitative knowledge, datasets and recommended courses of action for tackling specific societal or environmental conditions	Filling of community resource gaps (e.g. knowledge and manpower) through community-based research outcomes and planning or implementation of projects	Undertaking of management and planning roles to enhance synergy and collective impact of various stakeholder activities and relations. Can also contribute research results or design and implementation of projects or experiments	Fostering of stronger relations and flows of knowledge between stakeholders and university. Can also contribute the design and implementation of experiments

(continued)

Table 2 (continued)

Model	1. Project-based learning	2. Transacademic research	3. Internships	4. Project management and planning	5. Stakeholder interactions and sustainability experiments
Examples of social impacts from cases	• Local spending experiment adopted by City of Oberlin and implemented annually • Knowledge of alternative lighting solutions assisted industry learning in Malmö	• Data on vacant lots and forest carbon absorption potential forms evidence for future policy action in Kashiwa for the municipality • GHG emissions inventory forms backbone of climate policies and pursuit of climate neutrality in Oberlin	• Tree-planting carbon fund allows community learning on how local investments can advance carbon reductions in Oberlin • Student internships enabled production of climate action plans in Oberlin	• Management and planning role in Environmental Dashboard project aids promotion of a shared vision of community sustainability in Oberlin and educational usage of socio-technical innovation • Improved synergy between numerous faculty and stakeholder activities, and demonstration of novel approaches to biomass production in Kashiwa	• Realisation of working community models for re-activating underexploited land, urban environments and elderly residents in Kashiwa • Interviews with industry stakeholders facilitated sharing of knowledge and sustainability visions in Malmö amongst partners

involving stakeholder interactions and fieldwork, this typically takes place through formal classes and curriculums (O'Brien and Sarkis 2013; Wiek and Braden 2015). Being a student-centred pedagogy, the role of instructors typically concerns facilitation and coaching to improve the delivered 'product' (Savery 2006). Project-based learning is a significant driver of student participation in Oberlin and Malmö. With several professors and researchers in each institution engaged in research, steering and project implementation roles in that partnership, regular contact with external partners facilitates the tying of classroom resources to stakeholder needs and activities. Since the same professors and researchers have continued these efforts, this has allowed the feeding of results across multiple courses and groups of students. Although this model emphasises implementation and generation of actionable knowledge, examples in both cases typically begin from research on the assigned community problem, as well as potential solutions or 'best practices' from elsewhere.

In an example from the Oberlin Project, junior undergraduate students in 2014 collaborated with the local Chamber of Commerce to design and implement experiments to stimulate the local economy. Starting with research examining best practices and benefits of local shopping, students conceived and implemented a holiday season (November–December) strategy to incentivise this through a 'shopping passport'. This documents local store purchases, with accumulations of three or more earning $25 gift certificates, redeemable in any downtown business. To foster community support, they created fliers promoting the benefits of buying locally (learned from research) and mobilised local business owners to stay open later during important town events. The Chamber of Commerce has since adopted this strategy as an annual programme. In another example, a 2013 course 'Sustainable Cities' began by studying worldwide examples of sustainable urban design such as smart growth and new urbanism. The entire class then collaborated to design and submit a proposal for the development of a vacant lot owned by the City in response to a Request For Proposals (RFP). After consulting with numerous community stakeholders, students presented to City officials a design for a mixed-use development with a park, jogging trail, bike parking, commercial space and greenery. Although impacts on City planning is uncertain, incorporation of sustainable planning theory, stakeholder consultations and socio-ecological needs provided officials with an alternative development option to a conventional, cost-efficiency driven proposal.

In the Malmö Innovation Platform, student contributions concern mainly the provision of research outcomes. In a course Applied Research in Preventative Environmental Approaches, Master students engaged with an industry partner to identify creative outdoor lighting solutions and characterise their social and environmental benefits and implications. With results presented via a workshop, an important social impact was that this knowledge advanced the industrial partner's understanding of novel possibilities for outdoor lighting, thereby contributing to organisational learning.

4.1.2 Transacademic Research

Typically, transacademic research is transdisciplinary (crossing disciplines and societal sectors), participatory and community-based (Brundiers et al. 2010). Non-academic stakeholders are involved in all stages of knowledge creation—problem identification and definition, production of evidence (Gibbons et al. 1994) and evaluation of results. Equally, efforts are made to balance scientific robustness with social validity and utility (Brundiers et al. 2013; Lang et al. 2012). In all three cases, transacademic research proved a significant enabler of student participation and contributions to partnership activities. Notably, this occurred on an individual basis. Although this can occur through research assignments set through formal courses, the most notable examples in each case occurred through graduation thesis production.

Emphasis on student research and thesis production at the University of Tokyo fostered several instances of this model. One Masters student measured impacts on carbon absorption capacity and ecosystems from selective logging and community management practices in local woods (Uddin 2012). Residents and an NPO were engaged in establishing an experiment site and monitoring management activity impacts. Findings were then extrapolated to estimate carbon absorption potential of other forests in the area. In another example, a student surveyed the number and distribution of vacant and abandoned properties in the city through aerial photographs and onsite visits (Suzuki 2011). With research results from both examples shared with faculty and the local municipality, in the event that relevant policies actions are formulated in the near-term, this previously non-existing data will serve as important evidence.

At Lund University, two Masters thesis projects addressed issues related to the Malmö Innovation Platform. Knowledge production—largely conducted through interviews, site visits and workshop participation—involved extensive collaboration with corporate partners and residents. One thesis investigated and proposed business models for energy efficiency renovations in residential apartments (Kupchik 2014) with the other investigating the development of the Malmö Innovation Platform itself, and its mechanisms for pursuing retrofitting innovation (Gunnarsson 2014). The latter targeted the industrial, municipality and university partners in the steering group, with much data collected through interviews. A key finding was that deepening resident engagement is crucial to advancing the platform goals, and that economic and environmental expectations varied among participants. Findings were summarised into a brochure and shared with all partners. Through design and much input by the industrial partners, both thesis projects generated an important occasion for self-reflection by key steering partners on differing motivations, processes of innovation and effectiveness of the platform. Through scheduled meetings, events and activities alone, this internal self-reflection may not have otherwise occurred in such a structured manner.

In the Oberlin Project, a noteworthy example is an honours thesis project generating the first inventory for community-wide GHG emissions in Oberlin (Meyer 2009). Although a pre-requisite for any long-term strategy to reduce carbon

emissions, limited human and financial resources in the City previously prevented the collection of such data. Produced in collaboration with the local power utility and the City of Oberlin, the GHG inventory and baseline year (2007) emissions data now underpins a Climate Action Plan (City of Oberlin 2013) and subsequent monitoring of community-wide GHG emission reductions. In addition, it also allowed Oberlin to join the Clinton Foundation CPDP and pledge climate neutrality.

4.1.3 Internships

Student internships are highlighted in the literature as crucial for acquisition of first-hand knowledge and building inter-personal and professional competences (Domask 2007; Scholz et al. 2004). Efforts to create internship opportunities were unique to the Oberlin Project. By placing students in local government offices, businesses, NGOs and civic groups (or alternatively, directly in the project office) the project seeks to foster career development whilst allowing students to contribute to partnership goals through research and the design or implementation of sustainability experiments.

As key examples, in one project during 2013–2014, an intern worked with College and community stakeholders to develop a community-wide Oberlin Carbon Management Fund for fostering and managing local carbon sequestration projects. With credits of approximately 7000 tons/CO_2e required to attain carbon neutrality under the Clinton Foundation CPDP and Climate Action Plan commitments (City of Oberlin 2013), this initiative aims to ensure that funds for carbon credits remain in, and bolster, the local economy. This work drove the passing of a student vote at Oberlin College to levy $25,000 in student fees to fund tree-planting carbon sequestration projects. It has also evolved into a research and experimentation platform on carbon absorption potential and how local investments can advance progress towards carbon reduction targets. Student interns also contributed heavily to the design and drafting of the 2011 and 2013 climate action plans for the City of Oberlin. These plans adopted by the City paint the overall roadmap by which Oberlin will meet its goal of attaining climate neutrality and zero waste by 2050. They also provide information on GHG emission trends, incremental reduction targets and various City, College and community initiatives to advance sustainability. City resources such as manpower, knowledge and funding were previously insufficient for the creation of such documents.

4.1.4 Project Management and Planning

This participation model consists of ‘boundary spanning’ (Williams 2002) to manage collaborative knowledge production and problem-solving across societal sectors through various roles. As defined by the Brundiers et al. (2013) conception of a ‘Transacademic Interface Manager’, these can include (1) designing projects, (2) building relations among stakeholders and faculty, (3) mentoring students, and (4) implementing, managing and evaluating projects. Such roles are essential for maximising the collective impact of multi-stakeholder partnerships (Hanleybrown

et al. 2012) as they help avert common obstacles such as lack of unity and harmony amongst partners, poor management, leadership and co-ordination (Trencher et al. 2014a). This role was observed in case from Oberlin College and the University of Tokyo, which also required intensive research production. Contrary to the others, this model involves full-time formal employment and remuneration. Graduating students are ideal candidates for such roles due to their advanced knowledge, research skills and intimate understanding of university culture and local circumstances.

In the Oberlin Project, a recent graduate was recruited into a research and implementation project called the 'Environmental Dashboard'. Using electronic signs and websites, this combines real-time display of water/electricity use and water quality in buildings, organisations and the entire city to reconnect people with natural resource flows and promote sustainable action. The manager is responsible for coordinating collaborations with community partners to co-create digital content; overseeing the development and implementation of a K-12 curriculum integrating environmental dashboards in schools; managing a team of student interns assuming varied tasks such as computer programming, interviewing and photography; and working with government officials and utilities to extract and display aggregate city-level data. Through this collaborative design and management of a common digital platform, this position serves to promote a shared vision of a more sustainable community whilst advancing social uptake of emerging socio-technical innovation for educational purposes.

In the University of Tokyo case, a Doctoral graduate was placed into the *agriculture and green spaces* group. The specific research focus was on examining biomass production and associated CO_2 mitigation potential in local community-managed forests (University of Tokyo 2015). This position involved identifying suitable experiment sites and relevant community stakeholders, building stakeholder relations, data gathering, and co-ordination of large numbers of residents, municipality officials, NPOs and small industries into several experiments. These demonstrated novel socio-technical configurations to connect forest resources and elderly forest management volunteers with biomass production infrastructure. Through both research and experimentation, these explored the environmental, social and economic feasibility of utilising biomass for local heat and electricity generation. Impacts of this role included an improvement of the overall synergy and alignment between research activities of various faculty and socio-technical experiments, and the bolstering of community relations through active communication and meetings. Further, completed socio-technical experiments have laid the scientific and practical foundations for further community experiments and investigations, which continue today.

4.1.5 Stakeholder Interactions and Sustainability Experiments

In one sense, this category bundles diverse forms of community interactions and projects with stakeholders that occur independently of other participation models. Interactions can occur individually or in teams and may also involve the

collaborative design and implementation of sustainability experiments with stakeholders. Examples of interactions include interviews, participation in partnership meetings, events and scientific trials of emerging technologies. These interactions can be facilitated by faculty either through formal or credit-based courses and programmes (Allen et al. 2014) or take place independently and on student initiative. Despite the absence of distinct defining characteristics, we draw attention to this category for two reasons. First, such forms of participation were noted in all three cases, and second, 'learning by interacting' (McCormick and Kiss 2015) with community stakeholders provides students with important sustainability knowledge (Jiusto et al. 2013) and valuable insights into the messy and complex reality of collaborative efforts to advance sustainable development.

In the University of Tokyo case, important stakeholder interactions occurred outside of courses, largely upon the initiative of students, and with varying degrees of connection to student thesis production. Some also involved the co-creation of experiments with faculty, residents and government officials to demonstrate various approaches to reactivating decayed and underexploited urban spaces. In one initiative bridging the *urban planning* and *agriculture and green spaces* groups, students mobilised local elderly residents to convert vacant, private fields into vegetable and flower gardens and a site for outdoor gatherings and social exchanges. In another, students co-created a community meeting space 'IVY-LABO' by transforming an abandoned store into a hub for social and cultural activities between local elderly citizens (University of Tokyo 2015). Students drove the design and realisation of each experiment by spending extensive time in the field assessing stakeholder needs, building relationships and physically engaging in the realisation and running of each. Experiments were designed so that residents could assume ownership once university involvement withdrew. Consequently, both continue today, generating social activation opportunities for elderly residents whilst demonstrating innovative responses to urban decay and population aging.

In the Malmö Innovation Platform, stakeholder interactions are facilitated through formal courses. In a course titled Industrial Environmental Economy, Masters students performed group interviews with industry partners on their motivations and perceptions of the goals and activities in the platform. In another exercise, students from Lund University and two academic partners organised common events such as seminars, study visits and workshops with various stakeholders to gain insights into the challenges faced by cities when designing solutions for urban sustainability issues. Results of both these activities were presented to the City of Malmö and various industrial partners. These student-led interactions amongst stakeholders facilitated the exchange of knowledge amongst societal sectors. This was largely for the reason that students were seen as neutral and trustworthy 'outsiders' bringing in new ideas and creativity to the challenging task of stimulating urban renewal projects. This point was expressed by partners in the Platform at workshops and meetings.

5 Discussion

As shown in Table 2, the three cases involved multiple and varying approaches to integrating students into the co-creation of knowledge and experiments for advancing sustainability. Recalling that the research-driven case from the University of Tokyo lacked explicit educational objectives at the outset, the relevancy, choice and quantity of adopted models appears significantly influenced by institutional conditions and culture. One example is *internships*, which were unique to the Oberlin Project. Particularly in the USA, universities and colleges have established practices of providing internship opportunities for students (Brundiers et al. 2010; Domask 2007). At the University of Tokyo, efforts to provide internships to students are still developing and are not typically tied to research partnerships such as that examined. For *project-based learning* (highly exploited in Oberlin, and partially in Malmö), this model requires careful and strategic co-ordination across research, education and outreach functions and adjustment of course contents, assignments and assessment methods. This was largely achieved in the Oberlin Project. Explicit, initial objectives of exploiting this learning model to pursue partnership objectives promoted faculty and student awareness across campus regarding potential experiential education opportunities. Co-ordinating support also came from infrastructure such as a project office. Situated at the interface of local government, the community and the College, staff here work closely with faculty and community partners to co-design project descriptions that compliment the wider societal transformation occurring in Oberlin. Literature from the USA (Jiusto et al. 2013; Horrigan 2014) and to a lesser extent Europe (Brundiers et al. 2013) suggests high interest around problem-based learning approaches to sustainability education in these regions. At research-intensive institutions such as the University of Tokyo, this model is yet to take root due to historical emphasis on student research production, conventional lectures and, more recently, group field exercises in distant locations (Akiyama et al. 2012). That said, proliferation of other models of student participation such as *transacademic research* and *stakeholder interactions and sustainability experiments* from the University of Tokyo testifies that even without commitment from formal courses, students can nevertheless engage with sustainability co-creation if they perceive an overlap with their research interests.

Another point for consideration concerns the importance of increasing the collective impact of multiple participation models on collaborative efforts to purse partnership objectives. As observed in the Oberlin Project, a project office with full-time community-based staff is proving crucial in connecting otherwise dispersed efforts of individual faculty, departments, students and stakeholders. A key function of the office is to serve as a partnership 'memory' of past and continuing research, projects and experiments, as well as community needs. This is critical for aiding faculty to see how their own research and student resources connect with historical, present and emerging efforts to advance community sustainability and pursue partnership goals.

Findings also challenge views that the co-creation of knowledge and solutions for advancing sustainability is principally relevant to faculty, researchers and the research function of the university. In all three cases, faculty roles mostly concerned partnership formation, planning, direction and the supervising of student participation and learning. On the ground in each setting, however, students were key implementers of research and sustainability projects. Sustainability co-creation therefore has clear implications for education and ESD, where innovative and collaborative real-world learning processes with stakeholders have been promoted by the DESD (Tilbury 2011; Wals 2012, 2014). For ESD, findings suggest that if seeking to advance pedagogical innovation and experiential, collaborative forms of sustainability education, it would be inappropriate to view education as separate from research and community engagement. As suggested by the cases, these three missions can clearly be linked through the co-creation of transformational knowledge and sustainability experiments with external stakeholders (Trencher et al. 2014b). As all three missions are brought into synergistic alignment, this can engage the 'whole system of the university' (Tilbury 2011) with place-specific societal needs and sustainability challenges, whilst also contributing to their recursive and mutual development (Vorley and Nelles 2008).

6 Conclusion

By examining three contrasting and pioneering cases from Lund University, Oberlin College and the University of Tokyo, this chapter identified various pathways for students to engage with large, faculty-led partnerships for the co-creation of transformational knowledge and sustainability experiments with societal stakeholders. Those found to be particularly important are *project-based learning, transacademic research, internships, project management and planning,* and lastly, *stakeholder interactions and sustainability experiments*. Not overlooking varying levels of relevancy for each institution, these can be exploited in parallel, enable individual or group participation, and link to or function independently of established courses and educational programmes.

We have also shown that student participation, despite relatively short-term commitments owing to semester or degree schedules, can result in diverse and tangible contributions to collaborative efforts to tackle local sustainability challenges. To recall a few, these include the generation of fundamental datasets for informing policy, provision of both quantitative and qualitative knowledge through research, facilitation of relationship building in the field, design and implementation of sustainability experiments, and also, undertaking of partnership management and planning roles. By thus bringing knowledge, creativity and manpower to partnerships, student participation can drive societal progress to sustainability objectives by filling community resources gaps and the incapacity of faculty to spend extensive time in the field. Importantly, we also argued that the integration of students into the co-creation of transformative knowledge and sustainability experiments

with faculty and stakeholders can help align the three university missions (education, research and community engagement) with place-specific needs and challenges.

Despite such potential and seeming replicability, efforts to promote or upscale the forms of student participation examined in other university settings would confront several barriers. First-hand experiences of the authors and literary insights suggest that faculty could potentially encounter a lack of appreciation for experiential learning, interdisciplinarity and stakeholder collaboration—particularly from non-sustainability related fields or departments where specialisation and discipline-centric mind-sets are strong (Bacon et al. 2010; Daneri et al. 2015; Yarime et al. 2012). Other difficulties might include balancing the 'supply and demand' of community needs with the structure of the academic year (Brundiers et al. 2010), which can impede sustained or meaningful student contributions. Further challenges would also concern the need for students to navigate their dual accountancy towards faculty and needs for scientific validity with stakeholder expectations (Jiusto et al. 2013). Lastly, particularly for efforts to tie formal courses with societal research activities, difficulties would stem from the sheer challenge of co-ordinating large numbers of students and projects with the wider framework and objectives of partnerships for the co-creation of transformational knowledge and sustainability experiments.

Observations from the cases and insights from literature suggest some ways forward. Lack of faculty or departmental interest in real-world learning approaches and measures to integrate education, research and community outreach could be addressed through funding incentives. The potential of government funding programmes to influence faculty research objectives and entice societal collaborations to tackle localised sustainability challenges is well documented (Dedeurwaerdere 2013). This suggests that existing and new funding programmes could explicitly demand measures to integrate students and formal courses into sustainability research projects. By increasing the social legitimacy of efforts to integrate education, research and community engagement, such funding programmes would then justify budgets for the establishment of support infrastructure such as Transacademic Interface Managers (Brundiers et al. 2013). Such infrastructure could play a key role in macro-level co-ordination of partnerships and linking past, present and future contributions of faculty, stakeholders and students to the co-creation of sustainability advancing knowledge and solutions.

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Transition to Transformation in Fashion Education for Sustainability

Dilys Williams

Abstract

Contemporary practices in many educational and business establishments in Europe, the US, and elsewhere are built on an industrialized context set in motion in the mid 19th century, and further the accelerating digital and technological discoveries of the past century have been used to compound and multiply this perspective. This context has enabled the creation of incredible advances across a plethora of life's activities, giving freedom and opportunity to millions, whilst creating irreparable damage, loss of life and an increasingly imbalanced world for its inhabitants. The business and education of fashion exemplify this global changing of lives, and do so in a number of ways quite spectacularly as a sector, due to the singular nature of fashion; universal in society as a marker of identity and a mirror to culture and attitudes. Fashion also reaches into lives through its huge global impact (25+ million employees and vast resource use). Education for Sustainable Development (ESD) offers an apt location for the critique of current models of fashion education and business to be set against our ability to live well without jeopardizing our futures and our fellows. The emergent properties of our changing world require skills and aptitudes that are quite different from those previously acquired by (fashion) practitioners (Sennett in Together: the rituals, pleasures and politics of cooperation. Penguin, London, 2013), thus creating an imperative and an opportunity to bring together stakeholders from business, research and university teaching in a dialogue through ESD. Education offers an opportunity to foster new ideas that can take us beyond what already exists, with an emerging body of

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research (Sterling, Orr, Blewitt, Wals, Creigton) highlighting the need for systemic change in how and what we teach and learn. This chapter discusses the engagement of stakeholders in fashion ESD and introduces a co-created curriculum between world leading company Kering, whose portfolio of fashion brands includes Gucci, Stella McCartney and Puma, in partnership with globally reaching educator, London College of Fashion (LCF) at University of the Arts, London (UAL). The convenor of this partnership is the research centre, Centre for Sustainable Fashion, (CSF) where fashion is explored as a means to better lives through sustainability, and the principle investigator in researching this partnership is the centre's director and author of this chapter.

Keywords
Transformation · Co-creation · Design for sustainability · Bridge · Ecological literacy

1 Introduction

Educators in fashion nurture students in creating visions and actions for the future, whilst enabling them to join and contribute positively to the present. As a discipline it has potential to cross borders of theory with practice, link intellectual enquiry and industry application, and create dialogue across fashion's places of impact and influence. However, whilst directly reliant on resources and raw materials from nature, there is little evidence of fashion education that locates itself in that radical ecological paradigm that is most evidently needed (Chick 2013). The power that comes from the linking of knowledge in use (industry practice) and knowledge in incubation (teaching and learning) highlights the role of industry and business stakeholders. In this space the exchanging of practiced wisdom with academic stakeholders who are engaging speculative ideation processes can take place. Exploring how each are able to inform the other in a collective ambition; working towards better or new versions of what already exists, must be evaluated against the distinctive domains of commerce and education and their differing measures of success.

The partnership of Kering and LCF, created for the purpose of exploring ESD, acts as an exemplar in giving industry a role as contributors to the future beyond usual business activities, and of education a role as generators of graduates with skills and competencies that may not yet be marked on job descriptions or interview questions. This chapter seeks to offer insights from the first year of this collaboration to other universities and businesses considering co-creation of curriculum in ESD. This does not suggest that engaging stakeholders from industry and education in ESD can be in any way generalizable, but the high profile and commitment of participants in this case is distinctive, and the ripple effect of its endeavours can already be seen inside and beyond the organisations involved.

2 The Origins of a Connected Curriculum

University education holds in its arms a vital dynamic between the exploration of self, society, commerce and the world; its ambition, role and purpose considered through discussion in homes, government offices, businesses, charities and public spaces. From the establishment of the world's first university by Plato in around 385 BC (Hummel 1993), to universities in the 21st century, enduring values bind the term, whilst internal and external conditions dramatically affect their application. Plato's successor Aristotle established a premise for university education that contemporary educators can critically reflect upon; to marry a deep concern for the ethical and the political with an energetic curiosity about what makes for human flourishing. In the early 21st century, however, universities find themselves held in a perplexing tension. On the one hand, accessible to an unprecedented number of students, in the UK alone, 49 % of school leavers entered HE in 2011/2, compared with only 4 % in the 1960s (Department for Business Innovation and Skills 2013), but at the same time experiencing 'a disabling lack of confidence and loss of identity' (Collini 2012). If university education is to form both person and society, then why do we feel such a crisis of confidence? The answer is perhaps partly due, in a western university sphere, to political ambition for education that foregrounds contribution to a growth economy (Till 2013), based on sustaining a well established system that creates employability, generates income and increases competitiveness in global business. This is a contested space for universities in an art school system, whilst the great contribution of the arts to economy is visible in a variety of places and guises, its value lies beyond as well as within the creation of commoditised 'cultural products.' Interacting with stakeholders from across the system might offer ESD a means to empathise with tensions that exist, whilst simultaneously creating space for understanding at a systemic level what might be deemed right (ethically and morally), over what seems to be correct (technically and socially). Partnerships bring the outside into the classroom, but care must be taken not to compromise universities' ambition in exploring open notions of flourishing; exposing students to real world problems, informing must be focused on cultivating moral motivation (Podger et al. 2010), empowering them to radically resolve and dissolve them.

3 Fashion as Challenge and Possibility

Fashion education at university level encompasses an intertwining of theoretical, technical and practical elements that make up a range of artistic and business-focused manifestations of a phenomena close to the centre of the modern world (Svendsen 2006). This complexity can lead to a reductionist perspective on sustainability, focused on individual problems in its parts, to be solved by the cognitive skills of knowledge, but this approach often succeeds in disabling students who may feel burdened by the enormity of the problem (Fletcher and

Williams 2012). As a values-led process however, fashion education for sustainability offers the chance to explore affective learning, based on the unchanging values of what it is to be human from a more constructivist standpoint, piecing together how we might live well in the world. Yet many courses still tend towards traditional lecture-based delivery of fixed knowledge, and many students are focused on learning the correct answers to the problems, how to 'get it right' (LCF MA student feedback 2015), a tendency even in ESD (Shephard 2008).

Fashion as industry operates across vast scales from bespoke to mass production, creating livelihoods within communities and remote offices, its activities inextricably linked with the implications of 21st century living. Fashion involves the making of meaning (identity and belonging) and of matter (its material and 3D contents). It is a conduit to social acceptability, a route to aspiration in living and being; its power in these terms is phenomenal. In education, fashion requires affective and cognitive dimensions of learning. The cultivation of design, making, buying, selling, wearing, caring, socializing and influencing that make up the actions and artifacts of fashion involve us all. These actions are important in a world in which we are breaking the fabric upon which our existence relies, taking us into an unknown position in environmental, socio-cultural and economic terms (World Economic Forum 2015). Both as citizens and through roles that they take on, fashion graduates need to be conversant in an ecological literacy to shape the contents and contribution of a master tailor, image maker, performance sportswear designer, entrepreneur, strategic planner, buyer, exhibition curator, shoe maker, illustrator, merchandiser and much more besides.

Graduates from art and design courses, whether employees in established businesses (68 %, UAL 2013) or setting up on their own (18 %, UAL 2013) are not usually equipped with an understanding of nature or human flourishing as part of their skills set. For an industry in need of such skills, an interest in an exchange between business and academia offers a chance to enable future livelihoods for employee and employer alike. A common understanding of sustainability, shared by academia and industry, is that change comes through sharing and learning from others, based on the evidence that the challenges are too big for anyone to tackle alone.

4 Kering X LCF

As a practiced fashion designer, tutor and researcher, I understand first hand, the need and duty of care in preparing students for roles in fashion's industry, for destinations that offer opportunities, fulfillment and play out ambitions which may be rewarding and exacting in equal measure. But if higher education is to offer an expansive space for possibility to grow, then it needs to be more than a training ground for skills and competencies in an existing industry. Sustainability pedagogies offer fashion education a chance to move beyond a narrow vision of the commerce of garment making as a means for identity making. The experiential,

immersive, values-led uncovering through experimentation of who we are and where we are, through fashion ESD, might help us to learn to live well, together.

The Kering X LCF project involves a recognition of the imperatives for change and a vision for prosperity, equality and ideology based on living well in nature. The collaboration involves three levels of engagement:

Vision: An exchange of ideas in public, between industry and academia creating value in nature and society. To be realized through a series of five annual events.
Transition: Identifying a current challenge within a Kering fashion business and supporting a range of students in developing possibilities to solve or dissolve it.
Transformation: Co-creating masters level curriculum with a team from Kering, and CSF with LCF students and tutors, to enable graduate eco-literacy through validated courses. The sharing of methods, initial findings and plans for next steps seeks to inform the project going forwards and other industry/academia ESD exchanges.

Initial methods of exchange included face-to-face meetings, brainstorming techniques, ideology discussion, and teaching methods development in relation to ESD principles with reference to change agents guide (Moore 2005). Expected outcomes relate to student and industry expectations and course content development, leading to a prototype course, located in the second of three terms of the master's programme at LCF, open to M.A. and M.Sc. students.

In the first year, this collaboration has involved 40 students, 12 members of the Kering team, 7 researchers from CSF and 5 tutors from LCF. Students were selected to take part through application with a short statement, and a series of still images or a short moving image clip or audio statement about what they sought and might offer to the course. Participants were selected from design, business, media and culture courses. Students were asked to commit to a regular half a day together, across 15 weeks, to listen, question, contribute, view, make, share and present responses to ESD curriculum. The course was located directly before students developed proposals for their own major projects.

Course delivery consisted of mixed methods including workshops, lectures, formal and informal presentation, group work, tutorials and peer review. Critically, the course was delivered directly by Kering and CSF teams, following three key themes:

Theme One: Why Sustainability?

The programme involved creating a new starting position, through backcasting, forecasting, mapping of place, and values-based description of objects. This was followed by historical, cultural, social and climate science contexts of sustainability. Personal narratives of the sustainability journeys of the leaders of Kering's senior team, CSF researchers, and related applications of their ideas involved affective elements of research and business practice. Students, in teams, were asked to create manifestos as a means to commit to shared priorities, to begin to form an ethic in their work, and to decide any non-negotiable elements in their working practices.

Theme Two: Sustainability Systems
A visualization of the systems within which fashion operates set the context for sustainability in practice applied through a pioneering new system of natural capital accounting (Environmental Profit and Loss, EP&L). Students were introduced to a rationale and methodology for environmental accounting for fashion using data sets, scientific methods, and their application to design practice. Students reflected on this through a counter consideration of the stewardship of nature. Through role-play, lectures, workshops and student presentations, ideas were explored and progressed.

Theme Three: Sourcing for Sustainability
The course culminated in a series of insights into techniques, methods and knowledge bases used in selecting materials and processes for fashion products. A review of resources, resourcefulness, and fashion's human and material dimensions ran the gamut of fashion design for biodiversity preservation and conservation, fashion and social change, empowerment and social innovation, with first hand case studies from experts in the field of biodiversity, materials sourcing and sustainability co-ordination.

Through the course, students engaged in a reflexive processes to interpret, respond to and present ideas about how else fashion might achieve its ambition of identity making, culture shaping, community forming and livelihood enabling, through weekly contribution to an online workflow site. The range of ideas emerging from this immersive, discursive interface was presented to the leadership teams at Kering and LCF, and for the research team to analyze in developing year two of the collaboration. As this is a live and dynamic set of working practices, as part of a longitudinal study of graduate eco-literacy, this chapter offers a work in progress account of engaging actors across the system through a period of exchange.

5 Capture and Review

A range of methods captured feedback and learning from students, industry experts, tutors and researchers:

- One to one interviews, questionnaires, submission of text based responses, confidential feedback sessions and online student team journey capture.
- Review of student submission.
- Analysis of the above by CSF research team.

Emerging themes were identified from the content of submitted work in year one by cross course teams:

- Democratic design practice
- Materials led enquiry
- Social engagement as fashion business

- Storytelling for a generation of eco-literate children
- Media interaction to profile fashion as sustainability
- Extending experience beyond material product purchase

Projects were mapped across scales of change from business as usual, efficiencies made in current practice, to transformation, new paradigms and worldviews. In this first year, projects tend to cluster towards the lower end of change, but with encouraging signs of work starting to encroach outwards. The discourse between Better Lives and Living Well with Nature (CSF), and Empowering Imagination (Kering), uses Design for Sustainability methods (Walker and Girard 2013), Systems Thinking, Meadows and Wright (1972), and New Prosperity (Jackson 2009) with sustainability methods and practices developed and applied by Kering (EP&L, Materials Lab, Patagonia Wool project). Deep change involves deep understanding of motivations and imperatives for change, and the outcomes of year one must be viewed in relation to a western socio-economic context.

6 The University/Industry Semi-Permeable Membrane

Whilst distinguished by its level and scope of engagement, exchange between industry and education in fashion at university level is common. Often fluid, many tutors possess current or recent experience of industry practice, either through their own business or as employees across scales of business. Students and tutors therefore reflect on real life issues relating to practical, ethical, financial and commercial dilemmas and possibilities. Alongside this exchange of developing and applied knowledge in lecture, workshop or tutorial settings, more formal exchange between a course and industry frequently takes place through course validation processes, review and industry led projects, and competitions and awards. Just as the relationships of fashion involve a range of actors from farmers to brand managers, the location of a university might enable connection with particular regional elements of fashion, such as lace makers in the case of Moratuwa University, Columbo, Sri Lanka, SEWA women's co-operative in Pearl Academy, Delhi, India, and designers and retailers as in the case of London College of Fashion, UK. Through these relationships, universities may be able to contribute to local communities, cultures and ecosystems whilst maintaining a balance between mastery of a body of information useful to the current guise of those businesses, the 'industry ready graduate', and the students' capacity to challenge or extend the received understanding of a particular topic (Collini 2012). Educators have to wrestle with an ethos of care for the student, preparing them for employability, independence and participation in society, alongside skills that the world needs, but may as yet not fully recognize. This is a tough but exciting call. Educators are dealing with the future first and then linking back to the present as part of a change-making process, visualizing and making 'real' a holistic and collaborative model of fashion, which provides a vital way to bridge between different paradigms and contexts (Fletcher and Williams 2012).

The increasing rate at which our contexts for education and business are changing necessitates collective action committed to future prosperity, enabled by skills, values and knowledge to build social and ecological balance. This radical shift requires the development of methodologies of participation, the development of personal design ethic, and application of design for transformation, as well as methods of knowledge exchange and information led case studies, to enable the often-termed paradigm shift to a society that thrives within nature and with human equality at its core.

7 The Bridge

Kering X LCF creates a bridge, seeking an understanding of the means to thrive now, without jeopardizing our futures and our fellows. In places it remains within a modernist worldview, taking a microscope to see better how to reduce harmful and expand good aspects of fashion through technical, strategic, innovative, quantifiable methods. A close look at industry practices such as Kering's Environmental Profit and Loss system, offer unprecedented insights to educators and students, breaking new ground not fully evidenced in literature. In other places, the pedagogy steps outside this more mechanistic worldview, with more constructivist approaches that put things together in material and human relationship terms, a position well suited to the pattern forming tendencies of art and design. In this position, sustainability is 'an emergent quality arising from sets of relationships in a system, whether viewed at macro or micro scale' (Sterling 2004). Thus seen, we seek to build a system in which commerce resides, rather than one where commerce acts as fashion's sole identity, its common representation in contemporary discourse. In social and ecological systems, fashion also takes on a role to conceive and make, together; to share, express and exchange; to connect to available material resources and local knowledge; to create visible manifestations of identity and belonging in place and time; to offer novelty and delight, to enable livelihoods that offer autonomy, and to achieve fulfillment in self and community. Emphasis on this role of fashion is a bold vision for both industry and academia, each feeling the hot breath of political expectation based on growth, and driven to push the boundaries by economic activity in the hope that we'll find a way out of our problems further down the line.

Fashion ESD requires skills and values that help us transition from the current consumption model of commerce, based on an economic logic of surplus production and desire creation, to a post-industrial model, where livelihoods, delight and belonging are achieved within social and ecological balance. Such a transition in education inside and outside of formal fashion curriculum is taking place not only through the enquiry based learning of Kering X LCF, but also at California College of the Arts, KEA and Kolding in Denmark, Parsons, New York, Pearl Academy, Delhi and St Catherine University, Minnesota, USA, amongst others. Whilst critiquing the current fashion system, the great majority of these places engage interest from and collaboration with stakeholders from industry through what they do.

8 What ESD Might Offer to Fashion and What Fashion Might Offer to ESD

Locations of engagement of stakeholders in ESD in fashion can be mapped across scales from micro to global enterprises. Documentation of these thousands of change-makers would be impossible to précis here. From the use of fashion as radical place-making as by designer/activist Katie Jones, knitting her way to authenticity and new models for business, through to JJ Noki's House of Sustainability; these and other designers are also fashion tutors, sharing their design ethic, aesthetic and business dynamic. CSF's exchanges with businesses are built on the basis of mutual learning, understanding the current landscape, whilst imagining possible futures. Thus a widely understood role of designer as problem-solver is engaged, but new roles emerge; as sense-maker (Manzini 2015), as host (Williams 2015), and as guide.

The implications of such fluidity of exchange between stakeholders in ESD are that the methods, measures and contents of collaboration are often difficult to assess, whilst the rise in participants suggests positive impact from these engagements. The momentum of these interactions encourages us to give space to them whilst also seeking ways to engage stakeholders in ESD in more formalized ways. At the recent Business Climate Summit in Paris, convened to prepare for COP21 in Paris in December 2015, a resonant and clear statement was repeated; we are the first generation to really understand the imperative of climate change, and the last to be able to do something about it. However, sustainability has yet to radically change either fashion education or fashion business. Could a bringing together of each enable collective transformation towards sustainability?

9 What Do We Want to Sustain?

This is a question that was posed by John Thackara at the Cultures of Resilience gathering in London College of Communication in 2015. The day was 27th March; a date when students from three of London's most prestigious universities were protesting against cuts in funding across the arts. These students perceived that universities were showing little activism in questioning the nature of governmental constraints. The consideration of what we teach, how and why, seemed a particularly poignant discussion in terms of a student's and society's ability to flourish. The role of education and its interplay between the present and the future, between short term-ism and long term-ism, the familiar and the unknown, came into stark relief as a student spoke of the tension between the present (living, housing, employment conditions) and the future (concepts emerging through study). To create conditions for participants to engage in deep understanding of the

relationships between themselves, others, place, business, nature and society, we need to be able to recognize equilibrium from a systems perspective on the one hand, and in our own back yards on the other.

> "What can I actually do?" The answer is as simple as it is disconcerting: we can, each of us, work to put our own inner house in order. (Schumacher 1993: 252)

What and how we teach and learn must start with our values and the actions that we take then expand out to the systems within which we live (Capra and Luisi 2014). To enter into a dialogue about flourishing (Ehrenfeld 2008) we must recognize that we are the incumbents, as educational and business establishments, and to recalibrate how we assess progress within a systems view, deciding what is both the right and the best thing to do.

> Our perceptions of value, worth and etiquette differ according to the cultures and actions of those around us. (Henrich et al. 2009)

It is hoped that the strength generated by this stakeholder partnership will create a boldness to take us beyond what we might individually manage and risk. To transform education in fashion at masters level means supporting views on education and business quite different from the current status quo. The imperative is clear, but the actions need careful consideration. To encourage students to evolve possibilities based on a future that we can all enjoy, might mean radical change in what and how we teach, learn and do; business enacting change at a level that disrupts but does not destroy.

10 The Pushmi Pullyu

As a child, I was fascinated by Doctor Dolittle's ability to converse with a wide range of extraordinary animals, but what intrigued me more was one particular creature, the pushmi pullyu, a kind of llama with a head at both ends of its body. The notion of two simultaneous conversations, two lines of thought being played out in synchronicity, two landscapes to look out on, all seemed like a great idea to me. Many years later, as I reflect on the syllabus that we are drawing up as an interdisciplinary course in fashion for sustainability, co-created by members of the sustainability team at Kering, our research team at CSF, tutors and students, this fictional creature comes back to mind; the parallel strands of developing a 'knowledge system' and a 'belief system' shape the contents and the methods of the course. We seek on the one hand to navigate the complexity of sustainability applied to fashion through ways to inform decision making, suggesting intervention points in a system populated by diminishing resources, incomplete accounting systems, corruption, destructive practices, cultures of disposability and the commoditization of practically everything. The push towards better practices, efficiencies, extending value, switching materials or processes, closing the loop and offering what Manzini (1994) refers to as 'Existenzminimum' can create clarity,

confidence building and rational decisions about what 'matters.' Businesses, governments, educators and other organizations are exerting considerable effort in the push towards 'more sustainable' ways to create products, services and experiences that can create low carbon lifestyles and more resilience in an economy of diminishing returns. This push however, whilst offering a logical, rational approach that helps to make sustainability actions visible, measurable and impactful, involves incremental change. This type of push may reduce the current state of unsustainability, but does little towards creating a 'quality maximum' position, one that emerges from a philosophy, a belief, a conviction and ambition for a more expansive sense of being human and living with nature. The pull towards an imagining of a flourishing world on the other hand might do more towards the creation of sustainability lifestyles, than a myriad of checklists and information gathering.

Through the first phase of the exchange between Kering and LCF, we have been gathering conversations with members of Kering, LCF, and students, to understand the sustainability actions taking place in these business and education environments. Speaking to members of the Kering team with strategic and project specific roles reveals that whilst the job might entail a lot of energy and time focused on the push, it is the power of the pull that is seen as most transformative. This double helix that we are developing links back to the opening of this chapter, where a definition of fashion education lies between the assimilation of knowledge of its material contents, and the interpretation of its meaning. The marriage of the push of the technical and the pull of the philosophical is made through the practical, the making, and learning together. What we have learnt about the dynamic of the course, as CSF team member Kate Fletcher described to the students in her session, is that sustainability education is a functional set of knowledge, and something in your soul (Fletcher 2015).

11 Transformative Scenario Planning

In order to build a change-makers framework, we need to step out of our current position. From a viewpoint from within the current system, we are in a position of conflict, between the seemingly successful current scenarios within which both Kering and LCF operate (the logic of a post-modern consumerist economy), and the needs of a more equitable future. Conflict resolution has a number of methods and approaches from which we have much to learn. Adam Kahane shares methods that he has used in positions of extreme conflict in political and other terms; his method of convening offer useful ways to frame a collaboration understanding (Fig. 1).

Following this method, the prototype phase of the curriculum was conceived and tested out, whilst at the same time being observed, narrated and moved on through a reflexive process of questioning, interaction and analysis (Cunliffe 2004). Unlike most conflict resolution, the actors in this transformative planning scenario committed to ambitions of social and environmental balance through their work.

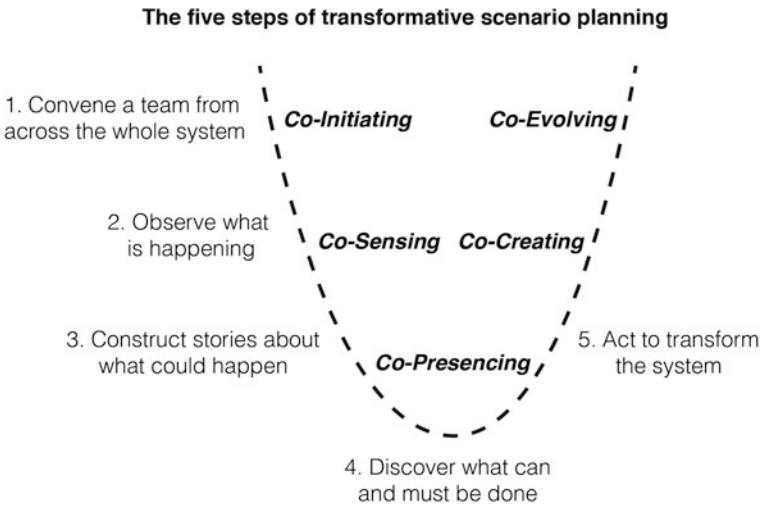

Fig. 1 The five steps of transformative scenario planning. *Source* Adapted from Kahane (2012)

12 Be the Change

Whilst Gandhi's quote "be the change that you wish to see in the world" is a well worn phrase, the shift to education for sustainability has been enhanced in this work by personal commitment on the part of participants, alongside a portfolio of knowledge to inform decision making. These initial insights are by no means generalisable either in terms of the partnership itself, which will evolve over the next few years, or the ways in which a range of stakeholders might engage in ESD. It does however offer a reflection on an immersive experience with deeply committed participants representing leading and high profile fashion businesses and educators. The art of co-operation and its practices are enhanced by shared purpose (Leadbetter 2010), but as we know, when the purpose is tangible, visible and responds to coordinated teamwork in a manner that is applauded by onlookers, participants become energized and encouraged towards success. But unlike the dedicated co-operation of a premiere league football team, the players in education for sustainability teams are seldom able to visualize the direct impact of their endeavours, and often lack applause or encouragement from onlookers who see the world as it 'appears'. We know full well of the challenges of sustaining co-operation. As we approach COP21, to be held in Paris in December 2015, our hopes focus on our ability to agree to the rules of the game; of living well on earth, within nature's boundaries. To this end we must hone and practice team-working skills. Whilst world-leaders in government struggle to work together, business leaders, students and tutors in the Kering X LCF partnership are exploring ways and

means towards a shared prosperity. How we demonstrate being human in nature, through fashion's agency, will contribute to our legacy as either making meaning or destroying what matters.

13 Findings and Conclusions

Engaging stakeholders in ESD through a five-year commitment enables a more experimental approach due to a longer 'payback' period and a trust in the partnership beyond the short term. Timescales for radical change in curriculum involve the existing course validation cycle, which in the case of UAL is a two-year process from initial registration of intent, through to final validation and recruitment onto courses. By allowing an open experimental curriculum to be developed and its learning to be taken forward into validated courses, enables exploration beyond boundaries and boundary changing. This also enables businesses to expand their consideration beyond a more usual problem minimising approach.

Participation in the transformation curriculum to date has led to high levels of sustainability engagement beyond the project. Whilst this cannot all be directly attributable to the partnership, with no previous data, the findings this year include:

- 60 % of students naming ESD course as 'definitely informing final master's projects', with a further 23 % 'maybe informing final projects' (student survey)
- 43 % of students 'definitely taking specific elements of group project into their final projects', with a further 43 % maybe doing so (student survey)
- Increased profile of ESD at LCF (press articles in news, fashion and sustainability publications)
- Students gain unprecedented insight into world-leading fashion business practice (student feedback)
- Dialogue between students and Kering has increased student employability skills (student feedback)
- Interdisciplinary teams have built networks, co-operative skills and knowledge exchange (student feedback)
- Gaps identified in incoming MA student ecological literacy (workshop session)
- Increased sustainability literacy evidenced through final presentation of student work (work review)
- Strong appetite for factual information for evidence based decision making (student interviews)
- Final presentations evidence some engagement in ideas of sustainability as an ethical imperative (work review)

> We are relying on educational institutions to create global citizens who understand the complexities of today's world. Sustainability should not be at the margins of our educational system but integrated into the core of our approach. Nothing is more important than providing the framework to educate and inspire the next generation to act and become the change makers we need.—François-Henri Pinault

Findings listed above focus on student activity and feedback, as they are key stakeholders in our collective futures. Implications for us as researchers and educators within our own and other locations include the necessity to create a feedback loop between knowledge in incubation and knowledge in action, through a dynamic that is mutually supportive whilst cognizant of different measures of success. The great majority of UAL partnerships with industry consist of businesses setting projects for students to respond to, competitions to apply for or contract research that responds to a particular problem or area in need of in-depth analysis. A distinction of this partnership is its ambition to provide ESD through co-creation and vitally, co-delivery of curriculum by all stakeholders involved. Implications for business include the need for support at senior level due to the substantial time commitment in building a mutual learning environment. Acknowledgement of the role of ESD in business innovation, and success and the recognition of the need for industry to contribute to ESD, made public by Kering's CEO Francois Henri Pinault when addressing a room packed with students, journalists, tutors, designers and others, evidenced leadership, commitment and a ripple effect, felt, but not always measurable, across both education and industry in fashion. For Kering, which has already committed to sustainability, and London College of Fashion, already committed to ESD, this acts as a major amplification and scaling of intentions. For places ripe for scaling up and shining a light on ESD, an exercise in assessing matched values could enable productive engagement of a similar kind. One of the most important elements of year one, not registered on ambitions or project plans, has been the trust-building on both sides, so that the next phase can scale, not only in reach but in boldness of contents and methods used in co-creating and co-delivering such curriculum. The necessary step from transition education, a refining of content and delivery to transformational education, moves us swiftly along the line from convening to discovery (see above) so that emphasis can be placed much more in the 'acting' phase of transformation.

Fashion, in its personal and mass industrial form, involves making of matter (the contents of fashion) and making of meaning (building of identity and belonging) thus offering a potentially interesting place to evolve educational programmes that 'transform perspectives and ways of being in the world' (Moore 2005). In order to evolve both our ways of being, and our ways of doing (education and business), we need highly visible projects relating to everyday phenomena such as fashion, alongside a range of other disciplinary approaches, to create a social as well as scientific consensus on our actions in relation to climate change and social change. Joined-up forms of knowledge (Parker 2010) require us to work both across disciplines and with stakeholders across economic, social, aesthetic and cultural dimensions of art and design education. It is hoped that this example, along with the others in this publication, can contribute to a landscape of change that paints a new picture of us in the world.

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The Great Problems Seminars: Connecting Students with External Stakeholders in Project-Based Approaches to Sustainable Development Education in the First Year

Geoff Pfeifer and Derren Rosbach

Abstract

The Great Problems Seminars program at Worcester Polytechnic Institute is a first year, project-based seminar series that aims to get first year STEM students to tackle real world, open-ended, and complex problems. We do this through an interdisciplinary team teaching approach that often includes local and international stakeholders. Each seminar focuses on one 'great problem' such as food, water, or energy. These courses culminate in student driven, team-based projects aimed at identifying and addressing some important aspect of the 'great problem'. In this process students work with external organizations (sustainable development NGOs, community organizations, businesses, etc.) to gain a real world context along with interaction with people affected by or engaged in solving these critical problems. Sustainable development education is a core part of the curriculum to prepare students to engage with external stakeholders. We have found that students really come to understand, and take ownership of many of the problems that they identify. In this chapter we will highlight ethical, pedagogical and practical challenges of this type of course, present successes, and describe our strategies for cultivating the evolving long-term partnerships with external organizations as they relate to ESD capacity building writ large.

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Project based learning · Sustainable development · Stakeholder engagement · Interdisciplinary · Higher education

1 Introduction

As is well known, sustainable development is, in its most general definition development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987, p. 8). More specifically, sustainable development attempts to take account of the spheres of the ecological, social, and the economic in ways that do not privilege one at the expense of the others, or as Dale and Newman (2005) have nicely put it:

> Sustainable development is the process of reconciliation of three imperatives, These are the ecological imperative to live within the global biophysical carrying capacity and maintain biodiversity, the social imperative to ensure the development of democratic systems of governance that can effectively propagate and sustain the values that people wish to live by, and the economic imperative to ensure that basic needs are met worldwide (352)

Sustainable development education then, attempts to teach principles and methods that lead to the further understanding of, research about, and practices around sustainable development.

As has been argued by many (Dale and Newman 2005; Jucker 2002; Steinemann 2003) teaching sustainable development is not the same as teaching a traditional, singular focused set of disciplinary competencies. This is because coming to understand what sustainable development is, applying its methods to specific problems and in specific contexts requires not only disciplinary knowledge from multiple areas, but also a set of transdisciplinary skills. Not only do students of sustainable development need to learn about and be able to apply concepts and epistemologies appropriate to ecological, social and economic study in the broadest sense, they also need to become good at targeting and finding the information they need in coming to understand a complex global/local problem from the perspective of sustainable development. This requires more than simple memorization of disciplinary facts. It requires that the student become able to integrate information from a variety of sources and a variety of contexts, forming it into new knowledge that can be applied in new and different contexts and in different ways. In short, sustainable development education is as much about helping the learner become a better researcher and critical thinker as it is about teaching the principles of sustainable development themselves. Thus, as Dale and Newman (2005) argue, teaching and learning about sustainable development is "process-based as well as fact-based; these tools must be flexible enough to generate appropriate responses specific to each individual situation and applied enough to allow engagement with global problems at the local level" (351).

For this reason, sustainable development education is best done through experiential, problem or project-based learning in which students face real-world problems, work to understand them, and offer solutions that conform to the principles of sustainable development. Participation and awareness are important aspects of sustainability education at institutes of higher learning (Drewel 2012) that can be increased through project-based courses. In such experiential learning, as Steinemann (2003) shows us, "students are given real world problems similar to those that would face as professionals. They take ownership of the problem, and the problem solving process. Instructors, in turn, take the role of cognitive coach" (218). This is because students are much more engaged when problems and challenges are viewed as authentic and not contrived to teach predetermined lessons. Through the process of the project, they must build the skills discussed above. Instructors, acting as 'cognitive coaches' work to help guide the student in the project process rather than simply give the student answers.

Such experiential learning is, in our view, best undertaken in teams or groups where students work together rather than individually on the project. This type of team-based, or cooperative learning also further enhances the skill-set or tools that are required for a good education in sustainable development. A ten year study in which researchers compared team-based cooperative learning with other forms of learning (individual and competitive) found that among other things, cooperative learning led to higher student achievement and more development of critical thinking skills than other forms (Johnson and Johnson 1984). Additionally we have found, that engaging other stakeholders in the project experience further enhances student learning and connects students even more to the process in ways that deepens their ability to understand and apply sustainability based concepts and solutions to the problems that the students face. We will discuss this more fully below, but we have worked with community partners across multiple iterations of our Great Problems Seminars courses (NGOs, schools, businesses, and other community members) and have found that doing this enhances the student connection to the projects and deepens their connection with and understanding of sustainability. Here is what one group of students, who worked on a project related to sustainable watershed management at a local pond, wrote in their learning statement at the end of one of our courses:

> When we decided on our project … we simply viewed this as a project that we had to complete. However, while conducting our interview [with a stakeholder]… we canoed along the pond and were able to experience the pond first hand. This changed our entire mindset about our project. Being that we were able to experience the pond itself, and the people who are so passionate about it, we felt much more compelled to do whatever we can to help. After this day that we were able to observe the pond, project work felt a lot less difficult. It was something that we wanted to do, not just meaningless tasks that we had to do. We now understand that the only way to truly help solve a problem is to experience the problem and those who care most about it.

Other students have expressed similar experiences and sentiments throughout our Great Problems courses as a result of both the format of the courses and opportunities to engage with stakeholders throughout the project process.

2 The Great Problems Seminars

WPI's Great Problems Seminars (GPS) are project-based courses that engage first-year students in real world learning, current events, societal problems, and human needs. Each seminar starts with an important global problem and helps students develop a project that addresses one small piece of a broader global problem. These courses were first developed to increase student retention in the first year but also serve as an introduction to WPI's project centered curriculum. In this way GPS courses fill the need that Brundiers et al. (2010) identify:

> Because incoming students are usually unfamiliar with the concepts and practices of real-world learning, they need to be introduced to those models, methods, and tools. This could be done through integrating an introduction to real-world learning paradigms into a regular course, such as an undergraduate methods course or the general introductory course for freshmen.

Each GPS course carries the credits equivalent to two courses and extends over two 7-week terms. The students spend the first term exploring the nature and extent of a particular great problem and searching for a piece of that problem they can address. During the second half of the course they work as a team to develop a solution to a smaller problem that the student team has identified that exists within the context of the larger great problem. This type of student driven project selection is not something most incoming first-year students have experience doing. As we will discuss more below, because of this lack of experience on the student's part, we design our courses to incrementally move students from short prescriptive assignments to one big open-ended project that engages stakeholders.

Every GPS course is co-taught by instructors from disparate disciplines generally one from engineering or the sciences, and the other from the social sciences or humanities. All of the GPS courses address sustainability issues and engage stakeholders to some extent. The three courses that we personally (collectively) teach are Power the World, the World's Water, and Biosphere, Atmosphere, and Human Fears, all of these courses have sustainability as a key component of the class. Due to the multiple pairings and expertise of instructors, however, each course and iteration of it varies to some extent but the GPS program has developed and shares a set of 7 common learning outcomes (Table 1) and each of the courses culminates in a set of team based final projects that are presented at a public poster session.

As Table 1 above displays, our learning outcomes are: cultural awareness, values, approach to problems, research, teamwork, writing, and presenting. These outcomes may look somewhat different than those for traditional classes. Competencies are favored over disciplinary specific content and objectives. As previously stated, sustainable development education teaches a diverse set of skills and the ability to generate new knowledge out of good research and critical thinking capacities alongside the concepts required for sustainable development work rather than simply absorbing a particular set of facts. Instead students must discern, evaluate, integrate, and apply the important facts that exist across multiple

Table 1 Learning outcomes for the great problems seminars

Cultural awareness	Articulate the differences in experiences of the "great problem" for stakeholders essential to development and acceptance of a proposed solution
Values	Describe your values and those of others as they relate to addressing the great problem
Research	Find varied, credible sources, assess their claims and relevance, and use them appropriately
Approach to Problems	When confronted with complex, open-ended problems, be able to identify answerable questions, and select and evaluate suitable solutions through the application of multiple perspectives and disciplines
Team Work	Collaborate effectively on a team
Presenting	Prepare and confidently deliver engaging and effective presentations
Writing	Produce clear, effective, evidence-based writing

disciplinary environments based on their relevance to the specific problem, place, and people they are working with. In order to reach these learning outcomes, as briefly noted above, we use a progressive approach where assignments and activities begin to introduce students to low-stakes but increasingly less structured learning opportunities in order to work up to completely open-ended, complex, and messy real-world problems that require sustainable solutions. Through each stage they gain more confidence and skill through practice and feedback.

An example of a first, low stakes assignment we use in our Power the World course is as follows: Students begin by exploring the various types of fuel used for energy production. They are prompted to answer questions about the origins and uses of particular renewable and nonrenewable energy sources, such as solar or oil, in relation to the social, economic, and environmental impacts of these types of energy production. Then they must do some team-based academic research on these sources, give a short presentation to the wider class about what they learned and also write a research essay. Additional assignments include a personal energy use log and reflection, a research notebook, a research workshop with our research librarian (whom students work closely with for the duration of the class), diversity training with the director of our office of multicultural affairs, and a larger, more open ended team-based global energy issues assignment. In aggregate, these experiences are designed to incrementally progress from basic to more advanced learning opportunities that prepare students for the development of their own project that engages stakeholders.

Students begin their major GPS projects by forming teams and choosing topics. Some choose based on common interest while others prioritize people. Next, each team identifies a particular issue they plan to address, like indoor air pollution or energy poverty, and a place where it is prevalent. There are a few GPS courses that skip this step and have predetermined projects that the students can choose from. The advantage with this method is that students can spend more time working on the problem and less time figuring out exactly what the problem is. The

disadvantage is that students do not have to do the work of identifying a problem, who it impacts, and at what scale it should be addressed. Further, a project that requires students to communicate with stakeholders in order to understand their needs has its own educational value. Often stakeholders do not agree and students are confronted with the complexities of trying to balance competing interests that confound real-world sustainability challenges. Past projects in our GPS courses cover a wide variety of topics such as, finding a sustainable solution to lack of lighting issues as a result of energy poverty in a small community in Sierra Leone, promoting sustainable water resources and STEM education at a local elementary school in Worcester Massachusetts, assessing the feasibility of LEED certification for WPI's aging Library, reducing cholera in Haiti through low cost biosand water filters, and sustainable cookstove designs to reduce indoor air pollution in Paraguay.

Once students have chosen a topic and done some initial investigation, they identify possible solutions that could address the problem. This is a variable and messy process that most students get frustrated with as they struggle through. Again, as noted above, something most, if any, of them have ever been asked to do. We do our best to prepare, guide, and support them through this phase. This is also when contact with stakeholders becomes crucial as it helps the students come to understand the varying viewpoints and experiences of those who are directly impacted by the problem.

Not all GPS courses have students engage directly with stakeholders and those that do fall on a continuum, as briefly noted above, from low to extensive contact. In our Power the World course we have found that having an organization, typically an NGO, mediate direct contact between stakeholders and students to be very effective. Especially necessary for students who want to work with communities in distant places like Africa and South America, these collaborations also help instill cultural awareness and prepare students for later experiences at our global project centers or careers where students are fully immersed in diverse cultures. In this way, students can be exposed to other cultures with less risk to themselves or stakeholders. This process is, however, not only effective for those student teams who want to work on issues in a global context, but for all teams regardless of where their project/problem is located.

After students have identified a problem and done some research, we ask each team to identify a set of stakeholders who are impacted in various ways by the problem the team is working on and contact them to gather more information. These impacts can range from direct–those who, for instance, directly experience the impacts of indoor air pollution from cookstoves, or who would benefit from LEED certification–to indirect, those who, for instance work for NGOs who work on issues surrounding energy poverty in Sub-Saharan Africa or who study sustainable watershed protection technologies. It is this type of stakeholder engagement that often pushes the student teams past the difficulties that they experience at the solution-identification stage of the project process. This is because actually talking to these stakeholders bridges the gap between the academic and intellectual understanding of the problem and the practical realities that it creates. All students are required to contact stakeholders associated with the problem they are addressing

but only a handful participate in what we consider sponsored projects. Each time the course is taught a few representatives of NGOs, companies, and local government agencies are invited to the class to solicit student involvement in potential projects. In many cases, those stakeholders that become partners and/or project sponsors for the remainder of the project process also become our partners in subsequent iterations of the courses, offering to sponsor student projects and/or helping convey their experience with the issues to new teams of students.

3 Project Partners

Partner organizations have the capacity to connect our students with communities all over the world and those nearby. Through this kind of relationship, students get to hear first hand from real people about the way they live and the challenges they face (Millican and Bourner 2011). Engagement with stakeholders would be difficult without the assistance of partner organizations like the Seven Hills Global Outreach, Fundación Paraguaya and the Coes Zone Task Force who have all been instrumental in shepherding GPS student projects (and/or connecting students with stakeholders).

Seven Hills Global Outreach (SHGO) is an Affiliate of Seven Hills Foundation that partners with health, education, and human services organizations in developing nations to "advance indigenous means to resolve global social challenges". SHGO has established long term partnerships in Ghana, Sierra Leone, Brazil, Guatemala, Haiti, Jamaica, and Bangladesh and are very adept at communicating the needs of their community partners to our students and helping the students recognize the importance of understanding community needs and capacities.

Fundación Paraguaya is an NGO aimed at eliminating poverty through practical, innovative, and sustainable solutions as well as a unique self-sufficient agricultural school for the rural poor. Through work with our students, Martin Burt, the founder and executive director of Fundación Paraguaya, has established a long-term relationship WPI including advising numerous GPS projects focused on food and energy sustainability in Paraguay that have even evolved into a permanent WPI Global Project Center.

The Coes Zone Task Force is a local collaborative effort to restore an urban pond and the broader Blackstone River watershed in Worcester Massachusetts. It consists of a diverse set of stakeholders including local landowners, city and state government representatives, NGOs, and academic partners. One group of GPS students worked with the Task Force to develop an outreach campaign to increase public awareness and engagement in restoration efforts.

During the project selection phase of a number of GPS courses, partners are invited into the classroom to introduce their organization and the challenges that the communities they work with face. This is when students get excited about working with stakeholders on an authentic problem rather than what the students described above as "meaningless tasks that we had to do". It also provides the opportunity for

students and partners to develop projects based on student interests and stakeholder needs. Students are more likely to take ownership and stakeholders are more likely to get useful and sustainable solutions.

Course assessments across GPS courses include end of course surveys with learning outcome specific questions, public project poster presentation events, program wide course project report evaluations, and reflective learning statements from students. Through these assessments we have found that project based courses in the first year that focus on sustainability enhance global awareness, values, the valuing of various perspectives, and problem solving. They also benefit from stakeholder engagement. One group of ambitions freshman even applied for and received a $4000 grant from a local non-profit to build a rainwater harvesting system at a local elementary school. Another team started a nonprofit to raise money to build new wells to access clean water in Africa.

Overall, students who engage with stakeholders have a positive experience. But we have found that some partnerships or methods of engagement are more successful than others. Teams that engage with only one or two stakeholders sometimes develop a myopic view of the problem/solution. Problems can also arise when student teams only contact academic stakeholders- as those types of experts can have the unintended effect of narrowing the student's view of the project and the solution. In light of this, we tend to prefer that teams contact a variety of stakeholders in order to avoid these kinds of issues. Given that our students in these courses are first-year students and for most of them, this is the first time they have ever undertaken this kind of work, we are understanding when these types of issues arise (and tend to think that, on balance, even those teams that end up in these types of situations, benefit more from them than they would without these types of interactions with stakeholders).

4 Conclusion

Project based learning can be an effective means to facilitate student engagement with stakeholders in sustainability education. WPI's Great Problems Seminars provide first-year students the opportunity to both broaden their understanding of sustainable development and also develop the skills necessary to work on problems and issues related to sustainability in a variety of contexts. These seminars also build foundations for later project-based experiences and work in students' professions. Instructors of GPS courses have increasingly moved away from traditional lecture formats and embraced the role of academic coach and structuring course assignments and course meetings to actively engage students in building skills through practice and feedback. Engaging stakeholders in this process has been a critically important component of the educative process in these courses.

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The Role of Solution-Oriented Knowledge Transfer Programme and Networking in Charting a New Course in University-Stakeholder Engagement

Omar Osman, Susie See Ching Mey, Kamarulazizi Ibrahim, Haslan Abu Hassan, Munirah Ghazali and Kanayathu Chacko Koshy

Abstract

Two major initiatives aimed at enhancing University-Stakeholder Engagement (U-SE) are addressed here. First, we discuss an innovative Knowledge Transfer Programme (KTP) introduced by the Ministry of Education in Malaysia in 2011 for which Universiti Sains Malaysia (USM) serves as the Secretariat. Since the beginning, KTP has committed approximately USD20 million to the programme split between industry 70 % and community 30 %, with a caveat of 30 % or more input from the partners. Since its inception, 349 projects (industry 219 and community 130) have been implemented throughout Malaysia, with the participation of more than 1400 academic staff, 650 graduate interns, and 3500 employees from Industry and Community. Secondly, we highlight the role of four international/regional Networks USM supports as Secretariat. In this context we wish to provide our experience and best practices involving, APUCEN (Asia-Pacific University Community Engagement Network), SEASN

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(South-East Asia Sustainability Network), ALKN (ASEAN Local Knowledge Network) and RSEN (Regional Sejahtera ESD Network). This paper will, thus, cover one major knowledge transfer programme partnership involving 'university-industry/community', and four specific 'network' initiatives designed to promote university-stakeholder engagement at a variety of levels. The range of knowledge transferred, approaches used, and the support provided by the university will hopefully provide replicable ideas to other aspiring higher educational institutions as they position themselves to be more proactively engaged.

Keywords
University-Stakeholder engagement · Knowledge transfer · Networking · ESD · Sustainability

1 Introduction

In keeping with the changing mindset sweeping through most modern universities that urges them to be more proactively attentive to the needs of the communities they serve, in addition to their normal academic quests, Universiti Sains Malaysia (USM) has been involved in a number of University-Community engagement initiatives aimed at promoting use-inspired and solution oriented knowledge production, dissemination and technology transfer. This transition is partly demand-led and partly relevance driven (Omar et al. 2012; Corcoran and Koshy 2010).

In this process, the university has learned that there are changes that must be made internally and externally to ensure a deep commitment to sustainable development in higher education that enables a lasting stakeholder engagement. This involves initiatives that universities should be doing themselves and also those involving higher education institutions and key stakeholders. In terms of implementation this recognizes usually three groups: (i) higher education institutions in-country; (ii) the disciplinary and professional networks of academics, professionals, and administrators, and (iii) the external stakeholders—particularly government, foundations, private sector, NGOs, media, parents, and students. From the turn of the century, USM has been following a somewhat similar approach by moving away from a 'project to a programmatic' approach for its stakeholder engagement. This requires on the one hand, modern scientific knowledge and skills, and on the other an altered perspective to see stakeholders as partners for their locally relevant knowledge and dexterity. Our experience is that universities will usually respond only weakly to stakeholder needs unless adequate financial support is available, the subjects involved command prestige in academic circles and a conducive policy environment that places stakeholder engagement in a structured larger context. Through our policies and practices, we have been trying to create such an environment where everyone sees value in partnerships and networks.

It is anticipated that the sustainability model used by USM (Sect. 2), and the practical examples presented under Sect. 4 on the Knowledge Transfer Programme (KTP) partnership, and Sect. 5, the Network engagement, will contribute directly to the thematic area, '*implementation of institutional strategies aimed at partnerships and networks for ESD*' of the book.

2 Background

By the turn of the new millennium, Universiti Sains Malaysia (USM) embraced a 'whole-institution' vision aimed at 'transforming higher education for a sustainable tomorrow'. In pursuit of this future, USM travels two parallel pathways. First, one that takes it on a competitive lane to attract quality students, competent staff, and adequate finances to achieve excellence, and the other that integrates major global sustainability challenges as highlighted by the Brundtland commission's report and its triple bottom line approach—environment, economy and society into its core mission activities. As a university that strives to support national development initiatives and human wellbeing right from its establishment in 1969, USM is convinced that the current development paradigm that depletes natural resources, increase pollution, change climate, and widen the rich-poor gap is simply not sustainable. This is the basis for the university's strong sustainability commitments (Clugston and calder 2014). This calls for interdisciplinary approaches that require a whole-system enterprise. Strategically, the sustainability choice of USM is its answer to the larger question of the university's 'relevance' to address major development challenges and the plight of the poor by reorienting the curriculum, promoting solution-oriented research, and engaging in knowledge transfer programs and networking involving stakeholder communities (Dzulkifli et al. 2010).

While all universities try to be relevant for competitive reasons, it may be argued that USM is 'selectively relevant', trying to excel, among others, in the strategically chosen area of sustainability. In order to achieve this ambitious goal we need an education that allows every human being to acquire the knowledge, skills, values and attitudes that empower them to contribute to sustainable development and take responsible actions for environmental integrity, economic viability, and a just society for present and future generations. This requires skills like critical thinking to understand complex systems, ability to imagine future scenarios, and capacity to make decisions in a participatory and collaborative way. Such an educational curriculum should, as contained in the outcome document of Rio+20, include the interrelated issues of poverty reduction, climate change, disaster risk reduction, biodiversity, and sustainable consumption and production in a locally relevant way (Kamarulazizi et al. 2015).

The type of education that meets these demands has come to be called Education for Sustainable Development (UNDESD 2005) and USM has been an ardent supporter of ESD through its Kampus Sejahtera Programme (Campus Well-Being 2000), Membership of the Regional Centre of Expertise (USM-RCE 2005) for

education for sustainable development programme, University in a Garden scenario (a metaphoric expression for a sustainability-led university 2006), Research University status (RU 2007), the Accelerated Programme for Excellence (APEX 2008) award from the Ministry of Higher Education, Malaysia and associated activities. In the implementation of these initiatives USM is influenced by the strategies and action plans of the United Nations Decade of Education for Sustainable Development and its post-2015 successor, Global Action Programme (GAP) on ESD (UESCO GAP Roadmap 2014).

Acknowledging that the integration of sustainability into the core of a university's mission areas requires a whole-institution enterprise that links major sustainability challenges on one hand with different educational approaches on the other, USM developed a model (Fig. 1) for mainstreaming sustainability across the university. In this model the interlocking circles on the left represent the three pillars of sustainability while the three circles on the right represent the common mission areas of Higher Educational Institutions and their ESD focus. The central box shows USMs priority areas for sustainability studies as represented by WEHAB+3 (water, energy, health, agriculture and biodiversity + climate change/disaster risk management, production/consumption and population/poverty. University-Stakeholder Engagement (U-SE) is seen within this model that contextualizes the social responsibility of universities in addition to their traditional role of generating and disseminating knowledge (Zakri et al. 2009).

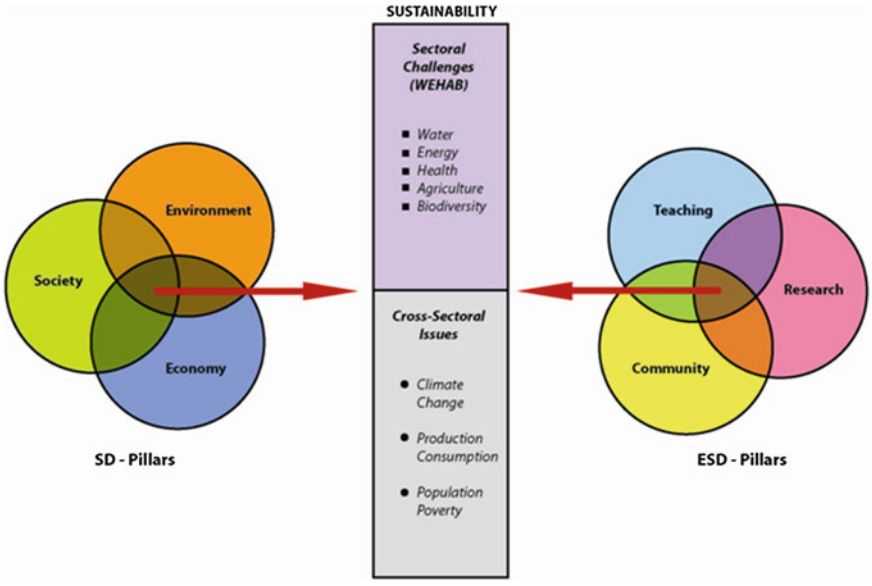

Fig. 1 An integrated approach to mainstreaming sustainability at USM. *Source* Centre for Global Sustainability Studies, USM

This model provides equal credence to U-SE as teaching and research and enables USM to view all forms of stakeholder engagement in that light. This negates the assumption that universities are the 'givers' of *knowledge* and *skills* and stakeholders are the 'receivers' that create a kind of rift not conducive for effective partnership. Further, 'engagement' suggests a different sort of relationship; that communities need to be active than passive partners if solutions are to be rooted in the stakeholders perception of needs and issues. While universities are up-to-date with the latest researched information, stakeholders are more practically oriented, often backed by years of experience and traditional knowledge. They are able to see issues in *perspective* and take decisions which are sensitive to the cultural *values* and ethics (Koshy et al. 2012). It is this symbiosis that strengthens U-SE through their mutual interest and influence. This is why 'educational administrators are increasingly recognizing what businesses have long understood: customer satisfaction matters' (Gross and Godwin 2005).

3 U-SE in Action

Within the context of universities, stakeholders are people, groups or institutions who have both interest and influence in a project or are those influenced by a project one way or the other. Since this would include a host of stakeholders, some degree of prioritisation has to be made for effective engagement. If the vertical axis in Fig. 2 represents interest and a horizontal axis the influence, we could consider four

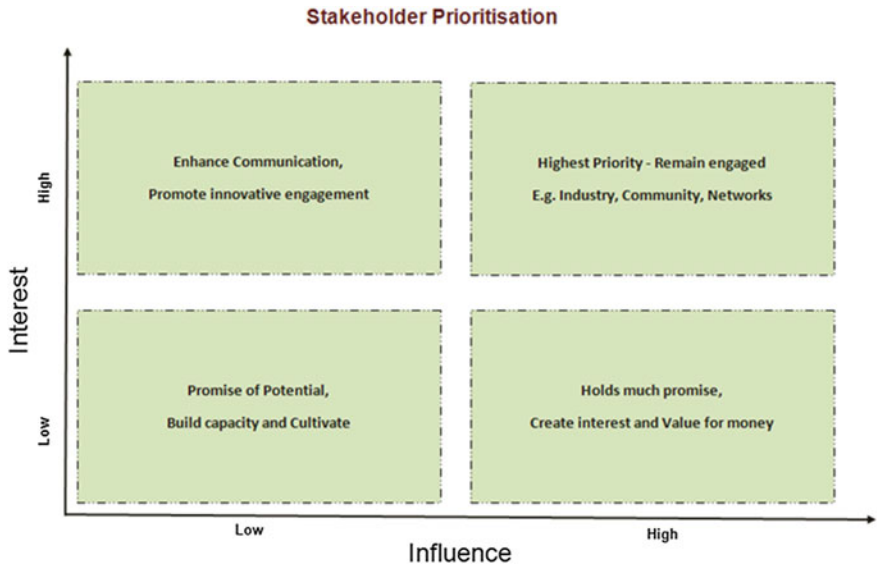

Fig. 2 Matrix to evaluate stakeholder interest and influence. *Source* Centre for Global Sustainability Studies, USM; Indebted to: Gross and Godwin (2005)

resultant quadrants (high/high, high/low, low/high, and low/low) (Gross and Godwin 2005). It is clear from this that while all stakeholders appear on the chart; those with both the greatest interest and influence are of the highest priority in competitive project implementation. This is the situation with the KTP initiative we wish to highlight in this paper. In addition, every stakeholder community comprises those in the other three quadrants as well. As networks are coalitions of the willing, everyone listens and learns from each other and improves their interest and influence. This way, universities would have created relationships with industries and employers who are willing to employ their students, while the external stakeholders who are willing to work with educators would achieve a match between what academia can provide and what the 'community' demands.

This recognition took a consolidated expression in USM with a number of focused initiatives, two sets of which that featured most for university-stakeholder engagement will be discussed below: (i) the Knowledge Transfer Programme (KTP) introduced by the Ministry of Higher Education in Malaysia in 2011 for which the National Coordinator and Secretariat are based at USM, and (ii) four regional/international Networks of professional stakeholders USM supports as Secretariat.

4 The Knowledge Transfer Programme (KTP)

The Knowledge Transfer Programme (KTP) is a partnership initiative by the Ministry of Education (MoE) under the Critical Agenda Project (CAP) of National Higher Education Strategic Planning (NHESP) for the 10th Malaysia Plan (2011–2015). The programme is funded by the Economic Planning Unit (EPU) under the Prime Minister's Department with an allocation of approximately USD20 million for the 5 years duration. USM is the National Secretariat for this programme and the USM Vice-Chancellor, Omar Osman, its overall Coordinator.

The KTP provides a platform for the collaborative work between academia and industry/community. The form of interactions may include consultancy, education, training, graduate development and placement, capacity building and sharing of physical facilities. Propriety, undiffused and formal relevant knowledge generated by the 20 public universities is transferred to targeted industry/community based on their specific needs. The industry can utilize the resources of public universities to enhance their business capability and economic activities, such as development and improvement of the quality of products and services, while the community can benefit from university-based knowledge to improve quality of life. In addition, the knowledge is transferred by Graduate Interns (GIs) so as to enhance their personal and professional development, such as gain experience, improve entrepreneurial skills and increase employability. Thus, the basic model for the KTP is based on strategic innovations involving academia, GIs and industry/community as shown in Fig. 3.

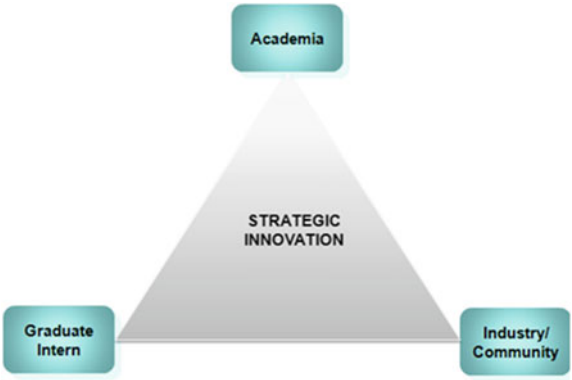

Fig. 3 The tripartite model of KTP involving academia, graduate interns and industry/community. *Source* Knowledge Transfer Programme Secretariat, USM

The funding from EPU is split between industry 70 % and community 30 %, with a caveat of 30 % or more input from the partners. Five Key Results Areas (KRAs) have been identified for the KTP that will spur industrial growth, community development and improve quality of life as a whole. These are,

(a) Education—raising the level of education in certain areas
(b) Economy—economic gain in identified sectors
(c) Sustainability and Green Technology Initiatives
(d) The Disadvantaged Groups
(e) Developing Industry/Community Relevant Curriculum (for High Impact Sectors)

Since its inception, 349 projects (industry 219 and community 130) have been implemented throughout the country, with the participation of more than 1400 academic staff, 650 GIs, and 3500 employees from Industry and Community (Haslan et al. 2014; Mohd Wira and Liyana 2015). Some successful projects which have shown positive outcomes and impacts are worth mentioning here.

First we highlight the seaweed cultivation management in the state of Sabah. The programme involves the transfer of knowledge related to the management of seaweed cultivation in a modern, systematic and proper manner to the management and staff of a local company. The knowledge transferred included farming technology and office management, human resources and financial management. After 18 months, farms have been better managed and organized, the harvest period has been reduced from 60 to 45 days, production was increased from 500 to 1300 kg per cycle and the sale has been increased. In addition, a standard operating procedure related to seaweed farming management was developed for use by any seaweed operator. Direct impacts of the programme are related to the improvement of the industry partner management, facilities and increase in sales.

The second successful project, related to sustainability and green technology, was the vermi-composting of vegetable wastes in a wet market, partnering with a local council in the state of Selangor. The project transferred valuable knowledge on how to convert municipal organic waste into bio-fertilizer using special worms.

The project created public awareness in urban waste management and promoted the use of vermi-compost recycling practices. Transfer of technology involved setting up training and construction of a pilot scale vermi-compost centre at the wet market. Using the technology transferred, all vegetable waste could be turned into bio-compost in a single step in a shorter time (30 %) compared to conventional composting process, thus eliminating bad smell too. Around 60 % waste reduction was achieved using this technique, and in return valuable compost product was sold as bio-fertilizers for the city landscape.

The third project was related to the concept of green building, which involved the detoxification of indoor air pollutant with nano-TiO_2 photocatalyst under visible light, partnering with a local company. In this project, knowledge and technology related to production of nano-TiO_2 solution were transferred to the industry partner. The nano-TiO_2 solution is sprayed on the inside walls of a building where it decomposed toxic air pollutants (consisting of various volatile organic compounds —VOCs) in the building through oxidation. An improvement in air quality of up to 70 % was achieved using this technology.

The final project was related to energy audit and best practices in energy efficiency with teacher education institutes. The relevant knowledge was transferred to staffs and students of two institutes, through training, workshops for master trainers, awareness campaigns, continuous monitoring and audit of monthly energy usage. Energy savings of up to 22 % have been achieved through zero cost best practices in energy efficiency.

In 2013, the KTP projects related to vermi-composting, air pollutant detoxification and energy audit have been selected by Performance Management Delivery Unit (PEMANDU) of Malaysian Prime Minister's Department and Project Management Office (PMO) of MoE to be implemented in the state of Malacca to drive the green technology agenda of the state, collaborating with Malacca Green Technology Corporation (MGTC). Vermi-composting is located at the Malacca Central Market, air pollutant detoxification at the Malacca General Hospital and energy audit at 30 secondary schools.

Several issues and challenges have been identified during the implementation of the first phase of KTP under the 10th Malaysia Plan. Among these are projects which are still heavily based on research thus preventing immediate transfer of the required knowledge, and graduate interns without the relevant background of the knowledge to be transferred thus requiring some retraining. Also some industries are unwilling to participate due to the 30 % compulsory monetary contribution to the program. These issues will be addressed by the 11th Malaysia Plan (2016–2020) KTP, which will serve and maintain the current KTP objectives with additional models added for improvement. The additional models will allow the exchange of knowledge between academia and industry/community, and a larger expert academia network involvement from various public universities. The amount of funding could be increased if a project has the capability to produce high technology impact, especially for high end industries.

In future, KTP will focus on projects related to the nine (9) National Priority Areas (NPAs) that contribute to the Economic Transformation Programme (ETP)—Biodiversity, Cyber Security, Energy Security, Environment and Climate Change, Food Security, Medical and Healthcare, Plantation Crops and Commodities, Transportation and Urbanization, and Water Security. It will move towards demand driven problem statement by the industry and the selection of suitable public university solution to match the problem statement, through a bidding process. It is also recommended that Green Technology approaches be used to address the sustainability issues relevant to the NPAs.

5 The Networks

5.1 APUCEN: Asia-Pacific University-Community Engagement

Motivated by the belief that Institutions of Higher Learning and the community can unite to co-create knowledge to enhance the social, economic, health, education, culture/heritage and environment of the community, the Asia-Pacific University-Community Engagement Network (APUCEN) was initiated by Universiti Sains Malaysia in 2010, with 25 interested universities from 3 countries. APUCEN was officially launched on 13 July 2011 at the APUCEN Summit, with 43 founding members from 10 countries. The general objective of this regional network of Institutions of Higher Learning is to promote the culture of university-community engagement in a proactive, inclusive, holistic and participatory way.

To realise this general objective, APUCEN pursues specific objectives, which aim to:

- promote and instill university-community engagement concepts and values to staff and students of Institutions of Higher Learning
- create capacity building for university-community partnerships
- disseminate and share information, knowledge, resources and good practices in community engagement
- implement joint flagship projects
- collaboratively develop resources to support regional flagship projects

In order to achieve these objectives, APUCEN provides an ideal platform through collaboration among its members and by connecting network-to-network from different regions. In so doing, it is moving towards building cross-functional and cross-institutional collaboration to improve the quality of life for individuals and communities. A series of national and regional meetings have been conducted with the aim of promoting the implementation of community-engagement at both national and regional levels. Initiatives have been started to share knowledge, resources and good practices in community-engagement through capacity building workshops and publication of its APUCEN Bulletin. APUCEN had begun

positioning itself as an international network by co-organising international events and establishing strategic partnerships with prominent international organizations such as International Science Shop Network, DVV International (Germany), Global Knowledge Initiatives, Engagement Australia, Engagement Thailand and Pascal International. Working closely with non-governmental organizations, governmental agencies, multinational corporations and student volunteer foundations, it is contributing to societal transformation and development.

As in April 2015, APUCEN has 73 members across 18 countries, namely Australia, Bangladesh, Brunei, Cambodia, Fiji, Germany, Hong Kong SAR, Japan, Lao PDR, Indonesia, India, Malaysia, Nepal, Pakistan, Philippines, Taiwan, Thailand and United States of America (Fig. 4). This is a reflection that APUCEN has not only built its presence in the Asia Pacific Region but also formed strategic alliances with network from the United States and European regions. APUCEN members enjoy benefits such as:

- having greater opportunities to network, collaborate, and form sustainable alliances in university-community engagement activities, projects and research;
- leveraging of resources, knowledge and expertise amongst its members to apply for competitive grants and funding;
- building and strengthening members' knowledge on university-community engagement

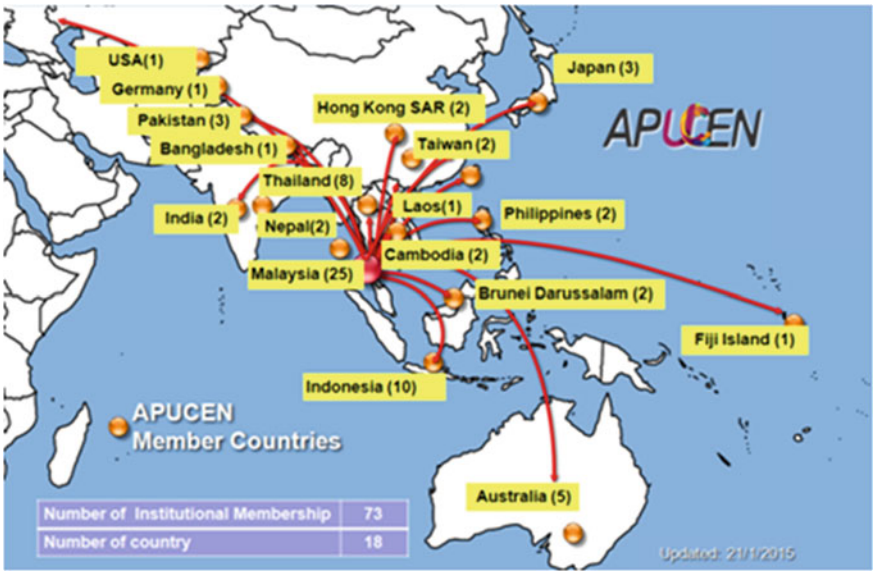

Fig. 4 The member countries of APUCEN and the number of approved membership in brackets. *Source* Asia-Pacific University-Community Engagement Network, USM

- showcasing best practices and niche areas of each member in community engagement; and
- disseminating and sharing of information on seminars, conferences and summit on community-engagement at the regional level.

Strategically, APUCEN has mobilized and shared expertise and resources to implement impactful community-engagement projects at the national and international levels. For example, APUCEN had mapped and profiled a total of 663 university-community engagement projects carried out from October 2012 to September 2013 by 11 universities from APUCEN@Malaysia members. More than one third of the university-community engagement projects are focused on three areas, Education (36.10 %), Economic (8.00 %) and Social (33.48 %). The remaining projects focused on Health (8.00 %) and Environment (5.80 %). Less than 5 % of the projects have multiple focus area (3.10 %) and cultural was the least focus aspect (2.72 %).

One of the successful university-community engagement projects conducted is the school project in Cambodia, which involved three universities, namely the Kyoto University of Foreign Studies (KUFS), the Sultan Idris University of Education (UPSI) and Universiti Sains Malaysia (USM), where all three universities are committed to improve the educational outcome and the wellbeing of the underprivileged communities in Cambodia. In this regard, APUCEN plays crucial roles to initiate and strengthen networking among members and leverage on each other's resources, knowledge and expertise for a common mission to improve the educational outcome and wellbeing of Cambodian children.

A leadership capacity training project involved the development of a module on university-community engagement for the university staff and students. The module was developed through a series of workshops and the project was funded by the Higher Education Leadership (AKEPT), Ministry of Education, Malaysia. Using the module, APUCEN had conducted a regional workshop for capacity building entitled "Constructing the Leadership Canvas in Community Engagement" in Padang, Indonesia on 11 November 2013. APUCEN members and community engagement experts from seven countries, namely Thailand, Germany, United Kingdom, Australia, Brunei, Indonesia and Malaysia attended this workshop. Experiences and knowledge were shared, and the workshop made a significant contribution to community engagement capacity building at the regional level.

With top management involvement, APUCEN as a concerted force will be able to lead and create a significant impact in community transformation in the Asia-Pacific region. Its sustainability depends on the fact that the President/CEO is the lead of the Member Institution and the Secretariat is permanently placed in Universiti Sains Malaysia with the Vice-Chancellor allocating an operational budget in managing the network (http://apucen.usm.my/).

5.2 SEASN: South East Asia Sustainability Network

The sustainability agenda in Southeast Asian region is not well championed compared to other parts of the world (e.g. EU, USA,). Realising this need, the Centre for Global Sustainability Studies (CGSS), USM, has taken the initiative to establish a regional network of higher educational institutions and others interested in sustainability promotion. This new set-up is called South East Asia Sustainability Network (SEASN), the membership of which is open to SE Asian countries. The vision of the network is to integrate sustainability at the core mission areas of the partner institutions and to lead by example. SEASN was launched on 28 October 2013 (Fig. 5) in connection with the International Sustainability Conference (29–30 October 2013) organised by the Centre for Global Sustainability Studies (CGSS), Universiti Sains Malaysia. SEASN provides a platform to support higher education institutions and other related sustainability centres in SE Asian countries by focusing on WEHAB+3—Water, Energy, Health, Agriculture, Biodiversity (WEHAB)+3; Climate Change and Disaster Risk Management, Consumption and Production and Population and Poverty. Although in the early stages of development, SEASN has already completed the following important activities:

(a) *The book project*: (WEHAB+3 Compendium): In order to catalyse sustainability research and teaching under the umbrella of SEASN, USM took the initiative of a book project on WEHAB+3. In connection with the inauguration of SEASN, USM published and distributed three books (Fig. 6): (i) *A selected literature review of USM research publications on WEHAB+3*, (ii) *Post Rio+20 on WEHAB+3*: *A Southeast Asian perspective* and (iii) *Disaster risk*

Fig. 5 SEASN was launched on 28 October 2013 at Vistana Hotel, Penang, Malaysia. *Source* Centre for Global Sustainability Studies, USM

Fig. 6 Book launch at SEASN, 28 October 2013, Vistana Hotel, Penang, Malaysia. *Source* Centre for Global Sustainability Studies, USM

management for sustainable development (DRM-SD)—An integrated approach (Koshy et al. 2013). The first is a literature review that summaries Universiti Sains Malaysia's Sustainability research output on WEHAB+3, mainly during the new millennium. The second is a compilation of articles by different authors from SEASN member institutions on the process and practice of sustainability integration in Universities within the context of WEHAB+3. The third is a comprehensive reference for community leaders and practitioners that treats progressive risk reduction through reactive and proactive approaches to address both natural disasters and major sustainability challenges as both types present themselves first as a risk and then disaster. (Books 1, 2 & 3 2013).

An E-book series, *A selected compendium of SEASN members research publications on WEHAB+3*, has also been published with contribution from several of the network members on each of the five sectoral and three cross-sectoral themes (www.seasn.usm.my).

(b) *Sustainability Training:* Under the ambit of SEASN two special training sessions on DRM-SD were conducted in Penang (2013) and Kuala Lumpur (2014) and training on sustainability with a special focus on a new Sustainability Assessment Methodology (SAM) developed by CGSS@USM was also conducted in Penang (2014).

(c) *Regional meeting on WEHAB+3 thematic Working Groups:* Based on a SEASN Board decision that Thematic Working Groups on WEHAB+3 needs to be made for more effective promotion of solution-oriented research in sustainability a special regional meeting is organised for November 2015 when thematic groups will consider country specific issues for targeted consideration.

There are numerous and diverse groups of individuals in colleges, universities and research centres across southeast Asia currently pursuing innovative strategies in environmental and sustainability education. However, existing efforts too often occur in isolation, remain small scale and provide little opportunity for

cross-fertilization. Although it is this need SEASN is trying to address, we admit there are both perceived and real barriers in terms of staff awareness, attitudes and institutional commitment to accelerating the network activities. It is also our experience that no grandiose idea will fly in the absence of sufficient and predictable funding. This is an area we are actively addressing through joint proposal development, exploring value addition possibilities to on-going activities and by approaching regional foundations.

5.3 ALKN: ASEAN Local Knowledge Network

Worldwide, there is increasing recognition of the intrinsic importance of indigenous knowledge and local cultures in sustainable development. A society's knowledge and its system for generating and maintaining that knowledge are cornerstones of its culture and these have strong communal elements. However, this knowledge is seldom codified and documented. In keeping with the world-wide efforts to reverse this trend, Universiti Sains Malaysia initiated 'Regional Conference on Local Knowledge' in 2011 (RCLK 2011) to be held in Malaysia. This conference with a theme of 'Retracing Tradition for a Sustainable Future' brought together practitioners, experts and scholars to its inaugural meeting in Langkawi, 10–11 October 2011.

Since this meeting where local knowledge itself was defined as knowledge and expertise which originate from local and indigenous cultures that have developed over time and from which practices that are absorbed naturally and effortlessly into the local communities. It is an accumulation of collective knowledge from lived experiences over long periods of time. Such wisdom traces its origins from local Malaysian cultures specifically, and cultures of the Malay Archipelago in general. The study on local knowledge is aimed at enabling social transformation through a paradigm shift that forefronts local epistemology.

During the second annual meeting of RCLK in 2012, Jerejak Rainforest, Penang, Prof. Omar, Vice-Chancellor USM, 6th from right in the rear row of Fig. 7, said that 'ever since the first conference, the secretariat has successfully published five books which are relevant to Local wisdom'. Out of the five books, two were written in English; 'The Relevance of Science to Local Knowledge and Retracing Tradition for a Sustainable Future: the Malaysian Experience'. The other books were written in the Malay language and are entitled 'Meneliti Khazanah Sastera, Bahasa dan Ilmu (Examining the treasure of Arts, Languages and Science); Meneliti Kosmologi' and 'Adat Istiada (Researching Cosmology and Customs); Berasal dari Akar' (Derived from the root). The two-day conference with the theme 'Engineering of Local Wisdom towards New Knowledge' witnessed the presentation of 107 papers covering a variety of topics under the framework of local wisdom. The latest of the annual conference was held in Kuching 12–13 October 2014, with a theme of 'Local Knowledge: Synergy—Sustainability—Dynamism'.

Fig. 7 Local knowledge book launch during RCLK in 2012, Jerejak Rainforest, Penang by Prof. Omar, Vice-Chancellor, USM; 6th from right in the rear row. *Source* Regional Conference on Local Knowledge 2012, USM

Given the increasing popularity of the Conference and the need to sustain local wisdom, USM established a stage for like-minded people to engage, called ASEAN Local Knowledge Network and is directly placed under the Secretariat of the Local Knowledge Group at USM.

ALKN is thus a major platform to facilitate researchers sharing and applying relevant local knowledge, values, ethics, cultures, and practices into current societal lifestyles with the goal of sustaining the positive, impactful and inclusive past practices for the future. Sustainability of conditions that permit humans and nature to co-exist in harmony without denying the environmental, economic and social needs of the present and future generations also create new knowledge in a world that is changing fast biophysically and socio-economically. The importance of such knowledge and its synergy to current sustainable development strategies attest to the fact that the relevance of local knowledge is timeless.

Knowing what local knowledge contains, how it is acquired and held is fundamental to being able to make good use of it and to encourage all parties to be aware of the added value its use will bring. This may find expression in traditional songs, stories, legends, dreams, dramas, methods and practices as useful means of transmitting specific elements of traditional knowledge. In virtually all of these, knowledge is transmitted directly from individual to individual. One of the major challenges of ALKN, therefore, will be to accurately codify this wealth of knowledge to sustain and make available for future generations.

(http://rclk.usm.my/index.php/en/).

5.4 RSEN: Regional Sejahtera ESD Network

Regional Sejahtera Education for Sustainable Development Network or RSEN is one of the key projects of RCE-Penang. RCE Penang (Regional Centre of Expertise on ESD), one of the seven foundation RCEs of the United Nations University's UNDESD initiatives, has been working with local and international education communities and engaging teachers in embedding sustainability principles in the school curriculum for over 10 years (Zainal and Hamoon 2008). It has set up the Regional Sejahtera ESD Network consisting of over 40 members (educational institutions, local government agencies and non-governmental organizations), which are committed to sustainable development. RSEN is unique because it brings together a variety of members who might not usually work together, but are capable of finding solutions to sustainability challenges. Working in collaboration and using active and social learning approaches, RSEN supports community stakeholders to integrate ESD across all aspects of education and learning.

RSEN has a Council of Members that meet at least once a year to discuss strategic priorities and activities. Furthermore, a roundtable discussion among all the members identified the following common ESD areas—Teaching and learning approaches, Climate Change Education, Traditional Knowledge and Ecosystem, Healthy/Sustainable Lifestyles and Water Education. Youth and schools were recognized as the target groups. Among the various on-campus and off-campus activities of RSEN (Fig. 8) are:

Fig. 8 RSEN activities involving on-campus and off-campus students, 2014. *Source* Regional Sejahtera ESD Network, USM

i. The Sejahtera Club: Sejahtera Club is a co-curricular education initiative led by RCE Penang. Schools which are members of the Sejahtera Club take part in leadership capacity building programmes in ESD. RSEN provides 1–1 support and guidance to schools and teachers to develop ESD projects and resources for the clubs. Among the modes of establishing successful Sejahtera Clubs are approaches to make all students of a school members of the club and starting new Clubs merging 'green' or environment clubs as appropriate.

ii. ESD Webinar Series 2015: This webinar series aims to introduce the concept of ESD at the school level and showcase good practice examples that can inspire schools and teachers to engage in sustainability.

iii. The RSEN Carnival: The focus here is on transferring ESD knowledge and skills to teachers through networking and action learning approaches.

iv. Network of networks: Since RCE Penang is one of the 130 RCEs in the world; it has been promoting international partnerships with other RCEs with similar mindset. For example, through its collaboration with RCE Greater Western Sydney, it organizes the Youth Eco Summit (YES), which seeks to develop students' leadership in sustainability. Schools in Penang connect virtually to the summit held in Australia and share their sustainability projects and initiatives. YES, is an award-winning global education event that is hosted annually in Sydney, and it showcases sustainability achievements in both primary and secondary schools. In another milestone event, RSEN/RCE-Penang was declared the 'RCE of the Year 2015' by the new Sejahtera Centre at RCE-Tongyeong, South Korea. It was at USM that the idea of Sejahtera first emerged in early 2000 as *Kampus Sejahtera* to ignite transformational changes in embracing the concept of sustainable development through education, even before UNDESD (2005–2014). It is satisfying to see, therefore, a Bahasa Malaysia word translated into a form of social innovation called the Sejahtera Forest which is a US$20 million ecopark supported by the Ministry of Environment, Korea. RCE-Tongyeong is part of this Sejahtera Forest (Dzulkifli 2015).

(http://www.rce-penang.usm.my/)

In spite of these achievements, RSEN faces its own set of challenges especially as a network involving many leaders from different organizations. It is also pertinent that in promoting various activities, RSEN reflects on the sustainability of the activities themselves. One mitigative measure we are taking is by organizing joint events which provide a common platform for stakeholder engagement. This is further enhanced through social media such as facebook and twitter. In addition, we are engaging school clubs with proper organizational structure within the Malaysian Educational system. In Malaysia, it is compulsory for students to be a member of at least one school club as part of co-curricular activities, and involvement in such activities contributes to 'good mention' in their school leaving certificate.

6 Conclusion

At the global level, the United Nations Decade of Education for Sustainable Development has been successful in raising awareness regarding ESD, has mobilized stakeholders across the globe, created a platform for international collaboration, has influenced policies and has generated large amounts of concrete good practice projects. At the same time, considerable challenges remain in that ESD policies and practices are often not properly linked and ESD has not yet been fully integrated into education and sustainable development agendas [UNESCO Report 2014]. Consequently, the global ESD commitment gained further strength when the UNESCO World Conference on ESD launched the Global Action Programme (GAP) on ESD. This post-2015 action agenda has identified five priority action areas: Policy support, Whole-institution approaches, Educators, Youth and Local communities to accelerate the search for sustainable development solutions among a variety of stakeholders through ESD.

USM's sustainability journey has a lot in common with the UNESCO experience globally. We too are convinced that multi-stakeholder dialogue and cooperation, involving industries, communities, education and research institutions, and government as we have described in this paper, are key to success in promoting ESD among all its stakeholders. While it is possible to leapfrog best practices of certain stakeholders, others benefit more from solutions to their professional challenges while for yet others, better awareness and enhanced capacity building would be the attraction. Through these interaction universities also stand to gain a lot about ways in which knowledge gets applied, knowledge preferences of stakeholders and the practical and intrinsic value of knowledge. For example:

The three KTP projects related to vermi-composting, air pollutant detoxification and energy audit have been adopted by the Performance Management Delivery Unit (PEMANDU) of Malaysian Prime Minister's Department and Project Management Office (PMO) of the Ministry of Education to be replicated in the state of Malacca to drive its sustainability agenda. Having spent USD20 million during Phase I (2011–2015),

In phase II the KTP concept and framework will be expanded and integrated in terms of its coverage and stakeholder engagement as part to the 11th Malaysia Plan (2015–2020). Stakeholder engagement with KTP is expected thus to contribute to national green development and to alleviate poverty by specifically addressing the issues of the bottom 40 % of the population (B40).

Through KTP, EPU of the Prime Minister's Department, MoE and HEIs are seriously working together to improve the performance of small and medium enterprises and the living standard of the nation.

All the four networks that we discussed have one thing in common and that is, universities engaging meaningfully with a variety of parties implementing projects relevant for the stakeholders. Since these projects are not one-off activities but are part of a long-term programme, we are also learning that university-stakeholder

engagement is a two-way process that by design yields beneficial results often through interative engagement and interactive learning. This requires an abiding commitment to the process, financial backing and institutional support.

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Engineering Education for Sustainable Development in Malaysia: Student Stakeholders Perspectives on the Integration of Holistic Sustainability Competences Within Undergraduate Engineering Programmes

Subarna Sivapalan

Abstract

The Board of Engineers Malaysia (BEM) stresses the importance for Malaysian engineering graduates to be sustainability literate. This is apparent in the 2012 Engineering Accreditation Council (EAC 2012) manual which outlines 12 graduate outcomes that Malaysian public and private universities are encouraged to integrate as undergraduate engineering programme outcomes, with some of the outcomes related to sustainable development. Although Malaysian universities are required to develop programme outcomes using outcome based approaches to learning, integration methods are not particularly outlined, perhaps to allow for academic creativity. To address the manner in which sustainable development outcomes could be integrated within the undergraduate engineering programme, a list of 30 hypothetical engineering education for sustainable development (EESD) competences was developed to address a holistic integration of sustainability outcomes within the engineering curriculum. Using a Malaysian private engineering university as a case study, this chapter focuses on the views of the institution's final year undergraduate engineering student stakeholders on the inclusion of these 30 competences. Stakeholders'

Parts of this study were presented at the 6th Engineering Education for Sustainable Development Conference (EESD13) held at the University of Cambridge, UK from September 22nd to 25th 2013.

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perspectives were sought through a 5 point Likert scale survey on the: (a) competences they deemed as important to enable them to become sustainability competent engineers when they graduate (b) competences they deemed as necessary to be included as learning outcomes of engineering modules and non-engineering modules, namely language and communication, business and management modules, and (c) competences they deemed as necessary to be included as learning outcomes of university level programmes. Survey results indicate that the student stakeholders found the 30 competences for (a), (b) and (c) to be important, with mean scores ranging within the 'somewhat important' to 'very important' levels. The 30 competences were further categorised into relevant sustainability competence dimensions through principle component analysis, upon which the findings of the analysis were presented as a set of guidelines for the holistic incorporation of sustainability competences within the undergraduate engineering programme. The implications of the findings of the study are also discussed in this chapter, with the hope of giving engineering education stakeholders a foretaste of students' views on integrating sustainability within the curriculum to advance EESD.

Keywords

Engineering education for sustainable development · Higher education student stakeholders · Undergraduate engineering programme outcomes · Sustainable development competences · Engineers

1 Introduction

Stakeholders are becoming increasingly integral to the advancement of sustainable development within the context of education at both local and global levels. Within the higher education sector in particular, internal and external stakeholders are deemed as key partners who can assist institutions of higher learning to advocate their core academic philosophies and beliefs (Barnes and Phillips 2000; Meyer and Bushney 2008) This is evident in the proclamation of the 1998 UNESCO World Declaration on Higher Education for the 21st century, whereby,

> Considering that a substantial change and development of higher education, the enhancement of its quality and relevance, and the solution to the major challenges it faces, require the strong involvement not only of governments and of higher education institutions, but also of all stakeholders, including students and their families, teachers, business and industry, the public and private sectors of the economy, parliaments, the media, the community, professional associations and society as well as a greater responsibility of higher education institutions towards society and accountability in the use of public and private, national or international resources
>
> (UNESCO 1998)

Asserts Leal Filho (2015), student stakeholders hold the key to promoting and catalysing change towards sustainability within the context of higher education. Ironically though, their voices are often disregarded. 17 years into the World Declaration on Higher Education for the 21st century, a critical concern remains in addressing stakeholder engagement. With the post-2015 ESD agenda kicking off, the need for systemic and strategic engagement of stakeholders, specifically student stakeholders, has never been greater.

Enthused by these stakeholder considerations, this chapter focuses on a study aimed at gauging student stakeholders' views on 30 hypothetical EESD competences developed by the author for potential inclusion as learning outcomes within undergraduate EESD programmes in Malaysia. To address the aims of the study, student stakeholders' perspectives were sought on the sustainable development competences they deemed as:

(a) important to enable them to become sustainability competent engineers when they graduate
(b) necessary to be included as learning outcomes of engineering modules and non-engineering modules, namely language and communication, business and management and social science and humanities modules
(c) necessary to be included as learning outcomes of university level programmes

Using a Malaysian private engineering university as a case study, this chapter focuses on the views of the institution's final year undergraduate engineering student stakeholders. Final year student stakeholders were the target respondents, given the length of the duration of their study within the undergraduate engineering programme, in comparison to undergraduate engineering students in their 1st to 3rd years of studies. Respondents' perspectives were sought through quantitative means, using a 5 point Likert scale survey.

It must be noted at this juncture that the findings reported in this chapter are part of a larger study conducted by Sivapalan (2015), which quantitatively and qualitatively compared and explored the perspectives of multiple higher education stakeholder groups on the development of a stakeholder defined framework for undergraduate EESD in Malaysia. This multi stakeholder assessment involved members of the university management, academicians, practitioners from the Malaysian engineering industry, ESD experts, ESD practitioners and undergraduate engineering students. This chapter, however, focuses solely on the voices of the student stakeholders, with the hope of bridging the gap on the limitations of research that addresses this particular stakeholder group.

Prior to the discussion on student stakeholders' perspectives on the integration of sustainability competences within undergraduate engineering programmes in Malaysia, it is first necessary to understand the context in which this study was conducted. The section below thus elucidates crucial political, educational policies and research landscapes within which this study was conceived. These include Malaysia's national stance on sustainable development, the place of ESD and EESD in Malaysia within this national stand, present EESD research priorities, and the lack of student stakeholder centric research efforts.

2 Background of Study

Malaysia, at the Copenhagen 15th United Nations Framework Convention on Climate Change (COP15) meet, pledged to reduce the nation's emission intensity by up to 40 % by the year 2020. In July 2009, the National Green Technology Policy and National Policy on Climate Change were developed in response to this pledge. Malaysia's National Green Technology Policy, according to Datuk Loo Took Gee, the Secretary-General, Energy, Green Technology and Water Ministry 'serves as the basis for all Malaysians to enjoy an improved quality of life, by ensuring that the objectives of our national development policies will continue to be balanced with environmental considerations' (The Star, November 27, 2010: p. 28). Accentuating the need for sustainability further is the incorporation of green technology elements in projects under the 10th Malaysia Plan. According to Malaysia's Work Minister, Datuk Shaziman Abu Mansor, as reported in The Star, the Ministry has set a target of 40 % for green technology derived projects and is open to new technology in the engineering and construction sectors to further develop greening efforts (May 20, 2011). The importance of sustainable development for Malaysia was further emphasized when the Prime Minister affirmed that the nation's human capital plays an eminent role in championing the need for a sustainability driven nation. During his address at the Commonwealth Business Council in December 2009, Prime Minister YAB Dato' Sri Haji Mohd Najib bin Tun Haji Abdul Razak explained the importance for Malaysia to nurture sustainability competent human capital if the nation was to resolve its sustainability challenges.

In discussing the need to develop sustainability competent human capital to remedy the nation's sustainability challenges, the pivotal role played by the country's national education system needs to be reassessed. The Malaysian National Education Policy, of which the seven National Higher Education Strategic Plan (NHESP) thrusts are also based on, emphasises the need to develop individuals who have the capability to contribute to the advancement of the society and nation.

> Education in Malaysia is an ongoing process towards further effort in developing the potential of individuals in a holistic and integrated manner; so as to produce individuals who are intellectually, spiritually, emotionally and physically balanced and harmonious, based on a firm belief in and devotion to God. Such an effort is designed to produce Malaysian citizens who are knowledgeable and competent, who possess high moral standards, and who are responsible and capable of achieving a high level of personal wellbeing as well as being able to contribute to the betterment of the society and the nation at large.
> (Malaysia Education Blueprint 2013–2025: Ministry of Education: 2013)

As such, given that sustainability has been, and will continue to be important national and global agendas for the country within political, economic, social, scientific and educational ambits, it is thus important for Malaysia's National Education Policy to be aligned with the country's developmental agenda. Additionally, Malaysia's education sector must also consider the vital role of education for sustainable development (ESD) within its national education system, given the

fact that the majority of the country's human capital are products of the country's primary, secondary and tertiary education systems. Likewise, within the context of higher education, specifically engineering education, the need to instil engineering education for sustainable development (EESD) awareness and competences is also crucial, as 'the need to educate the engineer of the 21st century differently—or more precisely, more strategically—is essential to the endurance of the profession' (Galloway 2008: p. 5). There is therefore an urgent need for Malaysian universities to advance ESD and EESD amongst its stakeholders, namely its engineering students and staff, so they would be better prepared to meet and embrace the sustainable development challenges the country will face, as it transits from a developing to developed nation by the year 2020.

EESD is rapidly advancing as a significant academic and research area within engineering education programmes. This is supported Byrne et al. (2010) whose study found that EESD has been receiving substantial international attention over the past ten years. The findings reported in their study were based on recent key research within the area of EESD, and indicates the importance placed by engineering institutions in developing graduates who are equipped with the competences to deal with sustainability. It is also interesting to note that most of the surveys cited in their study were conducted to gauge the extent to which sustainable development had been incorporated within the engineering curriculum. Some of the surveys also looked into students' perspectives of their understanding of sustainable development, and that of their lecturers. Based on the findings of this study, it can thus be suggested that there is a lack of research being conducted to investigate the types of competences that should be incorporated within an EESD curriculum. These findings additionally suggest that there also seems to be little research on interdisciplinary, multidisciplinary and transdisciplinary competences that should be included to develop a holistic EESD undergraduate curriculum.

These limitations are very much relevant to the EESD scenario in Malaysia, where 66.7 % of the Malaysian Engineering Accreditation Council's (EAC) engineering programme accreditation criteria are related to sustainable development competences. The Board of Engineers and Engineering Accreditation Council of Malaysia promote the need for sustainable engineering practices. Interestingly though, perspectives of the Malaysian engineering industry employers seem to suggest otherwise, as evident in studies conducted by Zaharim et al. (2009) and Mustafa et al. (2008). These findings are significant, as it suggests that Malaysia's engineering education programmes are not adequately preparing its graduates to be sustainability competent. It also indicates disparities between the expectations of the industry of its engineers, and the quality of sustainability competent graduates produced by local universities. These two studies additionally indicate a pertinent issue, i.e. a critical mismatch between the sustainable development goals envisioned by the engineering bodies and that of the engineering workforce employers and employees.

The inconsistencies that exist between the desired sustainable engineering outcomes and the actual sustainable engineering outcomes set within the Malaysian engineering workforce are indeed disturbing. As of April 23rd, 2014, a total of

74,601 graduate engineers have registered with the Board of Engineers, Malaysia. This is a strong indication that engineers who have graduated from engineering programmes offered by Malaysian universities make up a significant number of the engineers in the Malaysian engineering workforce. As such, when a significant number of the Malaysian engineering workforce employers and employees deem sustainable development awareness as irrelevant, it becomes evident that more appropriate measures need to be implemented at Malaysian universities to develop graduate engineers who are more empathetic to sustainable development and sustainable engineering.

Within the context of research, while studies on sustainable development in undergraduate engineering programmes in Malaysia do exist, it has nevertheless been confined to studies on first year students' perceptions of sustainable development and assessments of their level of knowledge and attitudes towards sustainability or sustainable development module development approaches. From a methodological perspective, most research on sustainable development within undergraduate engineering programmes in Malaysian universities has included quantitative and qualitative measures such as surveys, interviews and observations. Again, responses elicited have tended to target a specific set of stakeholders of the educational institution, namely, first year students. Some instances are cited in the paragraphs that follow.

Azmahani et al. (2012) for instance conducted a two phased mixed methods study on developing a structural model to assess first year undergraduate engineering students' knowledge and attitudes towards sustainability. Sheikh et al. (2012) looked at newly enrolled first year undergraduate engineering students' perceptions on sustainable development in a public university in Malaysia. The findings of the study suggest that the first year undergraduate engineering students were unaware of sustainable development. The findings of the study also indicated that the students were unable to explain what sustainable development was as they had not been exposed to it previously. It is felt that the suggestion that students were ignorant of sustainable development, as indicated in the Sharipah Norbaini Syed Sheikh et al. study, is rather prejudiced, as it suggests that Malaysian primary and secondary education does not develop sustainability awareness in its students. A study conducted by Meera et al. (2010) is evidence of the inclusion of sustainable development content in Malaysian primary and secondary education, where the findings indicate that 35 % of school students were knowledgeable of issues surrounding the environment. Although it can be argued that 35 % is of a low percentage, it nevertheless indicates that Malaysian undergraduate students, who are products of the Malaysian primary and secondary education system, have been imparted with sustainable development knowledge. The argument, however, is the extent to which this knowledge has been effectively instilled.

In another study, Arsat et al. (2011) reviewed 30 research articles to determine common models, approaches and orientations used by engineering programmes to develop courses on sustainability for engineering education. The findings of their study indicated that stand-alone and integrated models were most commonly used. In terms of orientation, the findings of the study indicated discipline specific

sustainability courses and interdisciplinary courses as the types of orientation preferred for the development of such courses. Approaches most widely used were either singular (emphasis is placed on either the environmental, social or economic aspects of sustainable development), dialectic (a combination of two aspects of sustainable development, i.e. environmental and social, or social and economic) or consensual (environmental, social and economic aspects are equally balanced). The study also found the singular approach as the preferred course development approach used in Malaysian universities.

To date, there has been limited research conducted to identify first hand, undergraduate engineering student stakeholders' perspectives on the inclusion of sustainable development learning outcomes within the Malaysian undergraduate engineering curriculum. To the knowledge of the authors, a study conducted by Sivapalan et al. (2015) is one of the few studies that explore this particular dimension of research. This study highlighted the educational practices and need for sustainable development within a private engineering university in Malaysia, and focused on the extent to which sustainable development is featured within the institution's programme educational outcomes and common modules. The study also explored pedagogical practices within the undergraduate engineering programme and student stakeholders' views on approaches best suited to teach sustainable development within the programme. The student stakeholder perspectives on the integration of holistic sustainability competences within undergraduate engineering programmes that is discussed in this chapter, is therefore an attempt at bridging this gap.

3 Gauging Student Stakeholders' Perspectives on the Integration of Sustainable Development Competences Within Undergraduate Engineering Programmes in Malaysia

As described in the introductory section of this chapter, views of final year undergraduate engineering student stakeholders were sought on the inclusion of 30 sustainable development competences they deemed as vital to enable them to become sustainability competent engineers when they graduate, competences they deem as necessary to be included as learning outcomes of engineering modules and non-engineering modules and competences they deemed as necessary to be included as learning outcomes of university level programmes. Student stakeholders' views were gauged via a 5 point Likert scale survey. The five points of the Likert scale denoted (1) for very unimportant, (2) for somewhat unimportant, (3) for neither important nor unimportant, (4) for somewhat important and (5) for very important, and was used to determine the final year undergraduate engineering students' opinions and attitudes on the 30 sustainable development competences developed.

A total of 388 respondents took part in the survey. The rationale for conducting the survey with final year student stakeholders was because they were almost finishing their studies and would thus have a better understanding of the whole

engineering curriculum over the period of their four years of study at the university. Gender and programme of study were not essential variables, as it was not the aim of this study to explore student stakeholder perspectives through segregated means, but rather as a concerted stakeholder voice. All 388 responses that were used for the analysis belonged to final year undergraduate engineering respondents who had completed or were taking modules from the common engineering, university requirement, English and communication, and the social science, humanities and national requirement list of modules offered in the undergraduate engineering programme. This was in compliance with the student stakeholder criteria of the study which required only final year undergraduate engineering students as respondents. As the above modules are usually completed before the final year of studies at the university, participants would be able to comment on the outcomes of these modules as they would have taken, or were presently taking them. This study took place from July 2011 to February 2012. The 30 items, which were developed based on a review of education for sustainable development literature and frameworks (i.e. Bowers 2000, 2001, 2008, 2009; Huckle 2006; Jucker 2002, 2011; Oreskes 2004; Selby 2007; Sterling 1998; Stibbe 2009; UNESCO 2002) were in relation to the holistic sustainable development and sustainable engineering competences engineering students need to be exposed to, to enable them to practice, appreciate and understand sustainable development upon graduation. The 30 items are as listed in Table 1.

A reliability analysis was first conducted on the 30 items. Assert Hair et al. (1998), the generally agreed upon alpha lower limit for Cronbach's alpha is 0.70. However, this value may decrease to 0.60 in exploratory research. The reliability analysis indicated very satisfactory values. The first issue, i.e. the competences necessary for engineering students to become sustainability competent engineers obtained an alpha value of 0.90. Competences deemed as necessary to be included as learning outcomes of engineering modules had an alpha value of 0.94, while the non-engineering modules, namely language and communication, business and management modules, an social science and humanities modules had an alpha score of 0.85, 0.95 and 0.95 respectively. Competences deemed necessary to be included as learning outcomes of university level programmes had an alpha score of 0.96. Although it was a newly developed scale, all alpha values were above the 0.70 cut off point stated by Hair et al., and as such indicate that the 30 items are indeed reliable.

In addition to the reliability analysis, an expert review was also carried out to determine the face validity of the 30 items. This expert review was conducted by a UNESCO Chair in Social Learning and Sustainable Development. Given his familiarity with the Malaysian engineering education scenario, and the outcome based education system, his review of the 30 items was instrumental for the development of the final set of items within the Malaysian context. His review indicated that all 30 items were appropriate and fitted well as programme and module learning outcomes.

The key findings of the study are discussed in the section of this chapter that follows.

Table 1 30 hypothetical engineering education for sustainable development learning outcomes

Items 1–30 of the holistic engineering education for sustainable development learning outcomes
1. Understand people's relationship to nature
2. Hold appropriate understanding of how the economy, society and environment affect each other
3. Hold personal understanding of the environment which is derived from direct experience
4. Local to global understanding of how people continuously impact on the environment
5. Understand how science and technology has changed nature and people's effect to the environment
6. Understand how cultural and social values influence how resources are viewed
7. Analyze a sustainability issue creatively, critically and systemically using scientific, social science and humanities approaches
8. Able to consider present and future directions of society and environment, and personal role and contribution to the future
9. Think of a holistic approach to solving an engineering problem
10. Think of a holistic approach to solving real life complex problems
11. Able to participate in groups consisting individuals from many fields or disciplines of study to jointly evaluate causes, put forward and work out problems, and provide solutions to problems
12. Apply engineering skills to solve real life sustainability problems facing society
13. Apply language and communication skills to solve real life sustainability problems facing society
14. Apply business and management skills to solve real life sustainability problems facing society
15. Apply social science and humanities concerns to solve real life sustainability problems facing society
16. Able to critically reflect on own assumptions and assumptions of others
17. Able to critically reflect on issues on a personal and professional level
18. Able to manage and direct change at individual and social levels
19. Able to express personal responses to environmental and social issues
20. Ability to demonstrate and articulate sustainability related values such as care, respect, charity, social and economic justice, commitment, cooperation, compassion, self-determination, self-reliance, self-restraint, empathy, emotional intelligence, ethics and assertiveness
21. Play the role of responsible citizens at the local and global level for a sustainable future
22. Develop appreciation of the importance of environmental, social, political and economic contexts of engineering processes for sustainability
23. Consider implications of engineering processes in relation to the environment
24. Consider implications of engineering processes in relation to the society
25. Consider environmental issues in relation to the society
26. Appreciation of all living entities
27. Appreciation that current actions can impact on the quality of life of future generations
28. Respect and value cultural, social and economic and biodiversity
29. Appreciation of the variety of approaches to sustainability issues
30. Appreciation for the need for lifelong learning in relation to sustainability issues and change

4 Key Findings and Guidelines for the Integration of Holistic Sustainability Competences to Advance EESD Within Undergraduate Engineering Programmes in Malaysia

Summarized in Table 2 are the mean and standard deviation values obtained from the analysis of the student stakeholders' views on the (a) importance of the 30 competences to enable them to become sustainability competent engineers when they graduate (SD COMP ENGNR), competences they deem as necessary to be included as (b) learning outcomes of engineering modules (ENGIN) and (c) non-engineering modules, namely language and communication (LNG & COMM), business and management modules (BSN & MGT), social science and humanities modules (SOCSCI & HMTIES), and competences they deem as necessary to be included as learning outcomes of (d) university level programmes (UNI PROG).

Further analysis in the form of a principle component analysis was conducted with the aim of categorizing the 30 items to enable it to be more meaningfully represented as sustainable development competences. The analysis entailed the following dimensions: Competences to become sustainability competent engineers, Competences for inclusion as learning outcomes in undergraduate Engineering modules, Competences for inclusion as learning outcomes in undergraduate English Language and Communication modules, Competences for inclusion as learning outcomes in undergraduate Business and Management modules, Competences for inclusion as learning outcomes in undergraduate Social Science and Humanities modules, and Competences for inclusion as University Programme objectives.

The results obtained are discussed in detail in the section that follows.

4.1 Competences to Become Sustainability Competent Engineers

As seen in Table 2, the findings on the importance of the 30 items to become sustainability competent engineers upon graduation indicate that all 30 items have a score of 4 and above. The highest mean score of 4.54 was recorded for item 5, *understand how science and technology has changed nature and people's effect to the environment*. The lowest mean score obtained was 4.03 for item 6, *understand how cultural and social values influence how resources are viewed.* These mean scores thus suggest that all 30 items are viewed by student stakeholders as important sustainable development competences they need to be exposed to, in order to become sustainability competent engineers upon entering the engineering workforce. Results of the Principle Component Analysis indicate three components being extracted. The components extracted were labelled to reflect the items it represented, namely,

Table 2 Sustainable development competences deemed necessary by student stakeholders (n = 388)

ITEM	SD COMP ENGNR		ENGIN		LNG & COMM		BSN & MGT		SOCSCI & HMTIES		UNI PROG	
	MN	SD	MN	SD	MN	SD	MN	SD	MN	SD	MN	SD
1	4.34	0.77	4.19	0.93	3.76	1.07	4.08	0.95	4.13	0.90	4.13	0.93
2	4.43	0.73	4.33	0.77	3.63	1.02	4.26	0.86	4.11	0.86	4.15	0.90
3	4.19	0.73	4.30	0.82	3.64	1.01	3.88	0.99	3.95	0.90	4.09	0.91
4	4.36	0.76	4.43	0.75	3.70	1.00	4.00	0.96	4.04	0.90	4.11	0.93
5	4.54	0.70	4.60	0.67	3.61	0.98	3.85	0.93	3.96	0.90	4.09	0.91
6	4.03	0.88	3.86	1.03	3.70	0.99	3.94	0.95	4.12	0.86	4.01	0.92
7	4.24	0.78	4.29	0.86	3.64	0.99	3.93	0.92	4.06	0.91	4.04	0.97
8	4.26	0.82	4.39	0.78	3.74	0.96	3.99	0.93	4.01	0.89	4.08	0.89
9	4.32	0.82	4.49	0.79	3.56	1.10	3.82	1.03	3.86	0.98	4.12	0.93
10	4.26	0.84	4.31	0.89	3.68	1.03	3.99	0.93	4.02	0.88	4.10	0.92
11	4.50	0.75	4.57	0.72	4.13	0.95	4.25	0.87	4.18	0.90	4.31	0.86
12	4.45	0.73	4.65	0.61	3.53	1.09	3.77	1.01	3.76	0.99	4.10	0.92
13	4.31	0.79	3.98	0.98	4.38	0.81	4.09	0.87	4.02	0.91	4.10	0.89
14	4.06	0.84	3.91	0.94	3.70	0.99	4.34	0.85	3.99	0.94	3.98	0.90
15	4.04	0.80	3.86	1.00	3.73	0.98	3.93	0.89	4.24	0.82	4.04	0.86
16	4.11	0.79	4.25	0.82	3.97	0.89	3.95	0.88	3.91	0.88	4.04	0.87
17	4.13	0.78	4.29	0.83	4.10	0.85	4.13	0.84	4.06	0.89	4.14	0.88
18	4.05	0.79	4.15	0.92	3.98	0.89	4.15	0.81	4.13	0.85	4.17	0.82
19	4.06	0.85	4.22	0.82	3.91	0.95	3.98	0.92	4.04	0.87	4.10	0.87
20	4.28	0.84	4.19	0.94	4.03	0.95	4.14	0.89	4.18	0.88	4.21	0.85
21	4.31	0.78	4.36	0.82	3.98	0.97	4.11	0.89	4.19	0.83	4.20	0.88
22	4.17	0.78	4.35	0.74	3.90	0.97	4.07	0.86	4.13	0.83	4.17	0.84
23	4.40	0.75	4.53	0.68	3.72	1.04	3.92	0.96	3.97	0.92	4.21	0.88
24	4.31	0.78	4.52	0.68	3.67	0.97	3.95	0.93	3.93	0.93	4.14	0.90
25	4.38	0.75	4.33	0.83	3.77	1.00	3.94	0.92	4.04	0.94	4.16	0.88
26	4.31	0.84	4.23	0.92	3.94	1.01	4.05	0.97	4.14	0.93	4.21	0.90
27	4.52	0.66	4.38	0.78	3.92	0.93	4.07	0.91	4.15	0.86	4.26	0.82
28	4.25	0.80	4.15	0.88	3.93	0.95	4.09	0.88	4.26	0.81	4.18	0.85
29	4.16	0.80	4.28	0.80	3.86	0.93	3.99	0.89	4.08	0.86	4.14	0.88
30	4.31	0.81	4.35	0.80	4.01	0.93	4.14	0.87	4.13	0.86	4.24	0.88

Note MN is in reference to mean score, while SD is in reference to standard deviation value Likert Scale range = 1–5. Items with mean values of 3.5 and above are deemed important

Component 1 Competences for comprehension, expression and demonstration of sustainable development consciousness (Items 1, 2, 4, 5, 19, 20 and 21)

Component 2 Competences for community based problem resolution (Items 13, 14 and 15)

Component 3 Competences for holistic problem solving (Items 9 and 10)

The mean score and standard deviation for component 1 were 4.33 and 0.56 respectively. The mean score for component 2 was 4.14 while the standard deviation was 0.67. The last component had a mean score of 4.30 and a standard deviation value of 0.77. The high mean scores indicate the importance of the inclusion of these components within the undergraduate engineering programme educational outcomes. This implies that the university is encouraged to include *Competences for comprehension, expression and demonstration of sustainable development consciousness*, *Competences for community based problem resolution* and *Competences for holistic problem solving* as key educational outcomes of its undergraduate engineering programme should it want to produce engineering graduates who are sustainability competent upon entering the Malaysian and global engineering workforce.

4.2 Competences for Inclusion as Learning Outcomes in Undergraduate Engineering Modules

As for the sustainable development competences for inclusion as learning outcomes in undergraduate engineering modules, the mean scores obtained for all items, as presented in Table 2, indicate that four items out of the total 30 items have mean scores lower than 4.00. These items therefore fall under the neither important nor unimportant category. These items are items 6, *understand how cultural and social values influence how resources are viewed,* item 13*, apply language and communication skills to solve real life sustainability problems facing society,* item 14*, apply business and management skills to solve real life sustainability problems facing society* and item 15, *apply social science and humanities concerns to solve real life sustainability problems facing society.* Even though four of the 26 items have a mean score of less than 4.00, these scores are above the average score of 3.50, indicating that these items are important to be included in the Engineering modules. Importance of an item was determined through the mean scores obtained, in accordance to its 1–5 value from the Likert scale. As such, items which obtained a score of 3.5 and above were deemed as important to be included as key educational outcomes, undergraduate engineering module learning outcomes and outcomes of university programmes. The remaining 26 items fall under the somewhat important to very important category, with mean scores higher than 4.00. The highest mean recorded was for item 12, with a mean score value of 4.65. Results of the Principle Component Analysis indicate four components being extracted, namely:

Component 1 Competences for appreciation of the need for sustainability consciousness within engineering practices affecting society (Items 22, 24, 25, 26, 27 and 29)

Component 2 Competences for the observation of sustainable development at individual and social levels (Items 6, 13, 14, 15 and 18)

Component 3 Competences for comprehension, expression and demonstration of sustainable development consciousness (Items 1, 2, 3, 4, 5 and 7)
Component 4 Competences for holistic approach to problem resolution (Items 9 and 10)

The mean score and standard deviation for component 1 were 4.35 and 0.60 respectively. The mean score for component 2 was 3.95 while the standard deviation was 0.77. The third component had a mean score of 4.36 and a standard deviation of 0.59. The final component had a mean score and standard deviation value of 4.40 and 0.76 respectively. The high mean scores indicate the importance of the inclusion of these components within the learning outcomes of the undergraduate engineering programme engineering modules. This implies that the engineering module academicians are therefore encouraged to include *Competences for appreciation of the need for sustainability consciousness within engineering practices affecting society*, *Competences for the observation of sustainable development at individual and social levels*, *Competences for comprehension, expression and demonstration of sustainable development consciousness* and *Competences for holistic approach to problem resolution* as learning outcomes and assessment criteria of the undergraduate engineering modules they teach.

4.3 Competences for Inclusion as Learning Outcomes in Undergraduate English Language and Communication Modules

In relation to the sustainable development competences for inclusion as learning outcomes in undergraduate English language and communication modules projected in Table 2, the mean scores of all 30 items indicate that five out of the total 30 items have a mean score of above 4.00. The items with mean scores above 4.00 are items 11 (mean = 4.13), 13 (mean = 4.38), 17 (mean = 4.10), 20 (mean = 4.03) and 30 (mean = 4.01). The remaining 25 items have mean scores less than 4.00. Nevertheless, these scores are all above the 3.50 average value, indicating that these items are viewed as important items to be included in the English language and communication modules. The lowest mean score was recorded for item 12, *apply engineering skills to solve real life sustainability problems facing society,* with a mean value of 3.53. Results of the Principle Component Analysis indicate three components being extracted, namely:

Component 1 Competences for the comprehension of sustainable development (Items 1, 2, 3, 4, 5, 7, 8, 9, 10 and 12)
Component 2 Competences for the expression and demonstration of sustainable development consciousness (Items 20, 21, 22, 25, 26, 27, 28, 29 and 30)

Component 3 Competences for implementation of sustainable development conventions within the community at individual, societal and professional levels (Items 13, 15 and 17)

The mean score and standard deviation for component 1 were 3.65 and 0.77 respectively. The mean score for component 2 was 3.93 while the value of the standard deviation was 0.75. The third component had a mean score of 4.15 and a standard deviation of 0.68. The high mean scores indicate the importance of the inclusion of these components within the learning outcomes of the undergraduate engineering programme English Language and Communication modules. This implies that the English Language and Communication module academicians are therefore encouraged to include *Competences for the comprehension of sustainable development*, *Competences for the expression and demonstration of sustainable development consciousness* and *Competences for implementation of sustainable development conventions within the community at individual, societal and professional levels* as learning outcomes and assessment criteria of the undergraduate English Language and Communication modules they teach.

4.4 Competences for Inclusion as Learning Outcomes in Undergraduate Business and Management Modules

In terms of mean scores obtained for the sustainable development competences for inclusion as learning outcomes in undergraduate business and management module, the results in Table 2 indicate that the mean scores of all items are above the average value of 3.50. This suggests that all 30 items are important to be included in the Management modules of the undergraduate engineering programme offered by the university. The highest mean score recorded was 4.34, for item 14, *apply business and management skills to solve real life sustainability problems facing society.* The lowest mean score was for item 12, *apply engineering skills to solve real life sustainability problems facing society*, with a value of 3.77. In addition, 50 % of the total items recorded a mean score value of 4.00 or greater. This is in contrast with the English and Communication modules, where only 16.67 % or 5 items of the total 30 items recorded a value of 4.00 or greater. Results of the Principle Component Analysis indicate two components being extracted, namely:

Component 1 Competences for the expression and demonstration of sustainable development consciousness (Items 20, 21, 22, 26, 27, 28, 29 and 30)

Component 2 Competences for the comprehension of sustainable development (Items 1,2,3,4 and 5)

The mean score and standard deviation for component 1 were 4.08 and 0.68 respectively. The mean score for component 2 was 4.01, while the standard deviation value was 0.74. The high mean scores indicate the importance of the inclusion

of these components within the learning outcomes of the undergraduate engineering programme Business and Management modules. The likeness between components of the English Language & Communication and Business and Management modules is an interesting observation which could be further studied as future research. This suggests that the Business and Management module academicians could therefore include *Competences for the expression and demonstration of sustainable development consciousness* and *Competences for the comprehension of sustainable development* as learning outcomes and assessment criteria of the undergraduate Business and Management modules they teach.

4.5 Competences for Inclusion as Learning Outcomes in Undergraduate Social Science and Humanities Modules

In the case of the sustainable development competences for inclusion as learning outcomes in undergraduate social science and humanities modules, the mean score of the 30 items seen in Table 2 reveal that all items have mean scores higher than the average value of 3.50. A total of eight items have mean scores below 4.00, while the remaining 22 items all have mean scores of 4.00 or higher. This indicates that all 30 items are deemed as important to be included in the social science and humanities modules. The highest mean score was obtained for item 26 (mean = 4.26), *respect and value cultural, social and economic and biodiversity*. The lowest mean score recorded was 3.76 for item 12, *apply engineering skills to solve real life sustainability problems facing society*. It is interesting to note at this juncture that item 12 also recorded the lowest mean score for two other modules, namely the English and Communication modules, as well as the Management modules. However, the same item had the highest mean value in the Engineering modules. Results of the Principle Component Analysis indicate two components being extracted, namely:

Component 1 Competences for the comprehension of sustainable development (Items 1, 2, 3, 4, 5, 6, 7 and 8)

Component 2 Competences for the expression and demonstration of sustainable development consciousness (Items 26, 27, 28, 29 and 30)

The mean score and standard deviation for component 1 were 4.05 and 0.67 respectively. The mean score for component 2 was 4.15 while the value of the standard deviation was 0.69. The high mean scores indicate the importance of the inclusion of these components within the learning outcomes of the undergraduate engineering programme Social Science and Humanities modules. These results indicate that the Social Science and Humanities module academicians could therefore include *Competences for the expression and demonstration of sustainable development consciousness* and *Competences for the comprehension of sustainable development* as learning outcomes and assessment criteria of the undergraduate Social Science and Humanities modules they teach.

4.6 Competences for Inclusion as University Programme Objectives

University programmes are in reference to university or student led activities organized as part of the undergraduate learning experience. These are programmes which have an educational impact on teaching and learning processes, i.e. educational seminars, conferences and engineering research competitions. As seen in Table 2, the mean scores obtained for all 30 items within the context of university programmes suggest that the 30 items are important to be included in university programmes. The mean scores obtained for all items were above the average value of 3.50. The lowest mean score was recorded for item 14, *apply business and management skills to solve real life sustainability problems facing society*. The mean score value for this particular item was 3.98. The highest mean score value was 4.26 for item 27, *appreciation that current actions can impact on the quality of life of future generations*. Results of the Principle Component Analysis indicate three components being extracted, namely:

Component 1 Competences for the expression and demonstration of sustainable development consciousness at individual, professional and societal levels (Items 18, 22, 23, 25, 26, 27, 28, 29 and 30)

Component 2 Competences for local and global comprehension of sustainable development using empirical and non-empirical measures (Items 1, 2, 3, 4, 5, 6, 7 and 8)

Component 3 Competences for holistic problem resolution (Items 9, 10, 11, 12 and 13)

The mean score and standard deviation obtained for component 1 were 4.19 and 0.67 respectively. Component 2 received a mean score of 4.09 while the value of the standard deviation for this component was 0.73. The mean score and standard deviation for component 3 were 4.15 and 0.74 respectively. The high mean scores indicate the importance of the inclusion of the derived components as learning outcomes of university organized programmes such as educational seminars, conferences and engineering research competitions. This suggests organizing committee members of university wide student programmes are thus encouraged to include *Competences for the expression and demonstration of sustainable development consciousness at individual, professional and societal levels*, *Competences for local and global comprehension of sustainable development using empirical and non-empirical measures* and *Competences for holistic problem resolution* as objectives of the programmes organized to help develop undergraduate engineering students awareness on sustainable development and sustainable engineering.

Following the results of the analysis, the competences were grouped to form a set of guidelines, as presented in Table 3. The guidelines proposed in Table 3 form an important outcome of this study, and illustrates the manner in which sustainability competences can be incorporated holistically within undergraduate

Table 3 Guidelines to incorporate sustainability competences holistically within undergraduate engineering programme outcomes and common module learning outcomes

Category guideline	Competences
Undergraduate engineering programme outcomes	
1. Competences for comprehension, expression and demonstration of sustainable development consciousness	1, 2, 4, 5, 19, 20 and 21
2. Competences for community based problem resolution	13, 14 and 15
3. Competences for holistic problem solving	9 and 10
Common undergraduate engineering modules	
1. Competences for appreciation of the need for sustainability consciousness within engineering practices affecting society	22, 24, 25, 26, 27 and 29
2. Competences for the observation of sustainable development at individual and social levels	6, 13, 14, 15 and 18
3. Competences for comprehension, expression and demonstration of sustainable development consciousness	1, 2, 3, 4, 5 and 7
4. Competences for holistic approach to problem resolution	9 and 10
Common undergraduate english language & communication modules	
1. Competences for the comprehension of sustainable development	1, 2, 3, 4, 5, 7, 8, 9, 10 and 12
2. Competences for the expression and demonstration of sustainable development consciousness	20, 21, 22, 25, 26, 27, 28, 29 and 30
3. Competences for implementation of sustainable development conventions within the community at individual, societal and professional levels	13, 17 and 18
Common undergraduate business and management modules	
1. Competences for the expression and demonstration of sustainable development consciousness	20, 21, 22, 26, 27, 28, 29 and 30
2. Competences for the comprehension of sustainable development	1, 2, 3, 4 and 5
Common undergraduate social science & humanities modules	
1. Competences for the comprehension of sustainable development	1, 2, 3, 4, 5, 6, 7, and 8
2. Competences for the expression and demonstration of sustainable development consciousness	26, 27, 28, 29 and 30
University programmes	
1. Competences for the expression and demonstration of sustainable development consciousness at individual, professional and societal levels	18, 22, 23, 25, 26, 27, 28, 29 and 30
2. Competences for local and global comprehension of sustainable development using empirical and non-empirical measures	1, 2, 3, 4, 5, 6, 7 and 8
3. Competences for holistic problem resolution	9, 19, 11, 12 and 13

engineering programme outcomes and learning outcomes of Engineering, English Language and Communication, Business and Management, Social Science and Humanities modules and University Programmes.

The guidelines presented in Table 3 can be used by the university for two core academic purposes, namely teaching and assessment. At the programme outcome level for example, universities wanting to produce sustainability literate future engineers through their undergraduate engineering programmes can infuse three key competence areas within the programme outcomes. The three key competence areas are (a) competences for comprehension, expression and demonstration of sustainable development consciousness, (b) competences for community based problem resolution, and (c) competences for holistic problem solving as a possible undergraduate programme outcome. Similarly, if academicians want to bolt-on or build-in module learning outcomes related to sustainable development knowledge, skills or attitudes in Engineering, English Language and Communication, Business and Management and Social Science and Humanities modules, the guidelines provide the key competence areas academicians should focus on to enable them to include these competences in the modules. For instance, English Language and Communication academicians who want to develop sustainability literate learners, or assess the extent to which their learners demonstrate sustainability literacy through these modules, could incorporate three key competence areas, namely, (a) competences for the comprehension of sustainable development, (b) competences for the expression and demonstration of sustainable development consciousness, and (c) competences for implementation of sustainable development conventions within the community at individual, societal and professional levels as learning outcomes or assessment measures within their modules. In addition, the guidelines can also be used as a checklist by academicians who wish to evaluate the extent to which their modules include sustainability outcomes, prior to any bolt-on or build-in exercise. The guidelines can also be used as an instrument to assess the undergraduate engineering learner's level of sustainable development competence or the learner's self-perceived notions of their level of sustainable development competence. It can also function as a needs analysis or quality assessment tool for undergraduate engineering programme managers to determine sustainable development outcome gaps within the existing undergraduate engineering curriculum.

5 Implications of Student Stakeholders' Perspectives on the Advancement of Sustainability Within Undergraduate Engineering Education in Malaysia

The findings of the case study highlighted in this chapter have provided some initial evidences on Malaysian undergraduate engineering student stakeholders' views on the advancement of sustainability within undergraduate engineering education in the country. The findings presented in this chapter suggest that student stakeholders place valuable importance on developing their competences to address sustainability related challenges they will face upon entry into the Malaysian engineering workforce. This is certainly encouraging, as it is an indication that student

stakeholders are sensitive and receptive to the notion that sustainability will be a vital component of their future career.

This case study has drawn many pertinent clues as to student stakeholders' perspectives on the advancement of sustainability within undergraduate engineering education in Malaysia. These findings are significant at several levels. For instance, the competences identified could be incorporated as sustainable development learning outcomes of the Engineering, English Language and Communication, Business and Management, Social Science and Humanities undergraduate engineering modules. These competences could also be used as outcomes or goals of university programmes organized as part of the undergraduate engineering learning experience. Additionally, these competences could also serve as assessment categories for the university's academic services department to evaluate the extent to which sustainable development competences are included in undergraduate engineering programme modules at the university. Last but not least, these competences could also be adopted by academicians as guidelines to assess their students' comprehension of what sustainability entails, and to understand the learner's self-perceived notions of their own levels of sustainability literacy.

In relation to the curricula and teaching and learning activities to achieve and support the inclusion of the competences identified, the findings obtained are an important indication for the university to put in place constructive measures to improve academic and institutional practices so that it is in line with the philosophies of education for sustainable development, as well as the aspirations of the university's key stakeholders, its students. These improvements include creating greater awareness of sustainable development amongst the campus community, enforcing clearer academic and institutional policies related to sustainable development and providing the necessary professional development and training for the academic staff to enable them to improve on their teaching skills and their understanding of sustainable development.

It is also felt that a reorientation of a programme's educational philosophies is essential to ensure that sustainable development outcomes are appropriately addressed within an engineering programme. Similar propositions have also been advocated by Orr (1992, 2004). In Malaysia, outcome based educational approaches are used as the corner stone for teaching and learning practices within engineering education. Measurable outcomes are developed at three levels, namely at the programme objective level, the programme outcomes level and the course outcomes level. It also emphasises the need for programme outcomes to be centred on the knowledge, skills and attitudes engineering students need to attain during their studies and upon graduation. Outcome based education is centred on the needs of students and stakeholders. As such, for sustainable development outcomes to be appropriately addressed within Malaysian undergraduate engineering programmes, it is important that the current outcome based approach for engineering education is re-positioned within an ESD lens, as supported by the findings presented in this chapter. When using a whole institution approach imbued within transformative educational principles, the potential of this re-positioning is immense, given the

similarities between teaching and learning approaches advanced by outcome based education and ESD.

It is also important to note that the incorporation of ESD as programme outcomes and module learning outcomes within the engineering curriculum cannot be a simple insertion to main sections of the curriculum, but rather to the engineering programme as a whole. Recent developments in ESD also indicate a notable paradigm shift in embedding sustainability within the curriculum, i.e. from being solely technically driven, to being guided by the social sciences and the humanities dimensions as well.

The manner in which sustainable development outcomes should be integrated within a curriculum is a further issue that has sparked much debate within academia. If sustainable development is to be addressed fittingly within the Malaysian engineering curricula, the need for a framework that thrives within scientific and humanistic angles is therefore crucial. As such frameworks are currently limited, developing a framework for engineering education that incorporates engineering, language and communication, management, social science and humanities perspectives would be advantageous for institutions wishing to incorporate ESD goals or assess the extent to which ESD goals are incorporated within their engineering programmes.

6 Conclusion

As this chapter draws to an end, I am compelled to emphasise yet again the importance of institutions of higher learning heeding to the voices of their student stakeholders. This is due to the fact that the findings presented in this chapter bear evidence that student stakeholders are very much driven to have their voice heard in making sustainability a core competence within their undergraduate engineering learning experiences.

This chapter, has in essence, looked into undergraduate engineering student stakeholders' perspectives on sustainable development competences they deem as important to enable them to become sustainability competent engineers when they graduate. The chapter also addressed their views on the sustainable development competences they deem as necessary to be included as learning outcomes of engineering, English language and communication, business and management and social science and humanities modules. Perspectives were also sought on competences deemed necessary to be included as learning outcomes of university programmes. Also presented were guidelines for the holistic integration of these competences.

Within the Malaysian context, the findings presented in this chapter would be useful to the Ministry of Higher Education, primarily in formulating sustainability related higher educational philosophies and guidelines for public and private institutions of higher learning in the country. Within an international ambit however, the findings highlighted in this chapter will be beneficial to institutions of

higher learning offering engineering programmes, as it would be able to inform university administrators and academicians of academic development aspects that need to be revisited or expanded within their respective institutional goals, engineering programmes or academic modules to make the incorporation of education for sustainable development within technical and non-technical modules a possibility.

In addressing the limitations of the study, it must be noted at this juncture that while generalizability was not the primary aim of this case study, the findings presented in this chapter could nevertheless provide university administrators and undergraduate engineering academicians teaching engineering, English language and communication, business and management and social science and humanities modules with an understanding of higher education student stakeholders' voices on the significance of integrating sustainability competences within the Malaysian undergraduate engineering programme. Future work could also be focused on expanding the pool of student stakeholders to those not in their final year of studies as it would also be interesting to explore and compare perspectives by study cohorts or programme cohorts. It is hoped that the findings highlighted in this chapter would be able to give engineering education stakeholders a foretaste of the potential of including students' stakeholders' views to advance sustainable development within the undergraduate engineering experience.

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University, Environmental Education and Community Engagement for Sustainable Development: A Study of the *Horta Escolar* Project, University of Southern Santa Catarina, Brazil

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Abstract

The promotion of sustainable development and ecological preservation is directly related to environmental education. Universities can provide mechanisms for devising and implementing various sustainability standards in their surrounding communities. This article presents the *Horta Escolar* Project, developed by the University of Southern Santa Catarina, Brazil, which aims to promote awareness of environmental conservation through sustainable practices in food production. This project resulted from a case study involving both primary school students and university outreach students, aiming to improve knowledge about sustainability and nutrition through the creation of a school garden allowing students to cultivate their own food. This process demonstrated

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that experiences of this type can effectively contribute to healthy eating and stimulating a culture of environmental preservation.

Keywords
Environmental education · Nutrition education · Research and extension · Sustainability

1 Introduction: Engaging the Community for Sustainable Development Through Environmental Education

Global changes influenced by human action affect the equilibrium of life on Earth, placing societies and ecosystems at risk to ongoing climatic changes (United Nations Conference on Sustainable Development 2012; Sachs 2007; Cubasch et al. 2013; IPCC 2007, 2014; Marengo 2015). Sustainable development to combat climate change has become increasingly applicable and a subject of paramount discourse among scholars at universities, governments and corporations, demonstrating a growing interest in the area of sustainable goods and services (Cornescua and Adam 2014). Direct investment in this area has incentivize sustainable development worldwide (Kardos 2014).

According to Dvořáková and Zborková (2014), "there is a growing effort to understand the possible network of relationships between the economic, ecological, social, and institutional fields of development and the means through which these spheres are measured of not only individual phenomenon, but also of their joint force". Development is related to the improvement of the quality of life of the population "through the processes of decentralization, local participation and valorization of the utilization of their own resources" (Guzmán 2015).

The integration of young people into discussions related to sustainable practices, preservation, and conservation of natural resources, all of which should be integrated into curricula, provide the interactions and exchange of knowledge necessary to promote social integration and search for solutions to social and environmental difficulties (Boisier 1997; Xavier et al. 2007).

One of the key components of sustainable development is education. Addressing the mitigation of anthropic impacts on the environment, UNESCO (1977) affirms that environmental education takes on a quintessential role in combating these issues.

Environmental education must be seen as an integral part of lifelong learning that values the diverse forms of possible knowledge that can provide citizens with both a local and a global environmental sentiment (Jacobi 2003), but many challenges exist to the development of sustainability principles and the creation of solid points of reference that can strengthen social and environmental awareness (Xavier et al. 2007).

Universities represent potential sources of support in the promotion of sustainable development, offering assistance in the construction of initiatives to aid their respective local communities in adopting feasible patterns of sustainability. López et al. (2015) and Katiliute and Daunoriene (2015) highlight the role of the university as an active agent in the effort to promote sustainable development, recognizing the component of social responsibility that the university offers to its community. Education remains an essential part in promoting a sustainable world that can successfully combat environmental woes (Thathong and Leopenwong 2014; Yurt et al. 2010).

Environmental education should follow an interdisciplinary approach, which, through experiential learning, serves to strengthen cooperation, inclusion, ethics, responsibility and commitment to environmental preservation and eco-consciousness (Ertekin and Yuksel 2014). Successful environmental education establishes a responsible society more cognizant of the impact of their actions on the environment (Simsekli 2015; Thathong and Leopenwong 2014; Yurt et al. 2010).

Derevenskaia (2014) and Rodrigues (2014) highlight the importance of courses dedicated to environmental content with the objective of young people becoming more aware of the great importance of environmental issues, integrating professors and students in an experience which allows students to act as active participants in the learning process.

Interactive educational methods, such as the creation and cultivation of student-run garden plots, facilitate the learning process by allowing the students to expand their leadership skills and become aware of their individual responsibility towards sustainable practices (Mingazova 2014). Among the methods utilized in this project, we can highlight the creation of the *Horta Escolar* project, developed by the University of Southern Santa Catarina, which encourages the active interaction of students with the environment.

Besides practical learning opportunities and student access to themes related to environmental competences, the creation of student-run organic gardens allow students to adopt healthy nutrition practices, guided by a more conscious consumption of fresh fruits and vegetables with no agrochemicals. This relationship has shown to be evident in studies and the experiences of student-run gardens described by Pimenta and Rodrigues (2011), Morgado and Santos (2008), Fiorotti et al. (2011) and Araújo and Drago (2011).

With the aim of addressing health issues that result from poor nutrition, such as obesity and malnutrition, environmental education can also offer nutritional education, promoting healthier eating habits (Castro et al. 2013; Ajie and Chapman-Novakofski 2014; Fung et al. 2013; Roman 2014).

Food consumption is no longer considered a purely nutritional act, instead becoming viewed as a larger social and cultural act. Motta and Teixeira (2012) argue that nutritional education of children is required to introduce healthy foods into their diet, changing their eating habits.

Investing in quality primary instruction with the introduction of environmental and nutritional education can result in a long term increase in regional development with a future adult population more conscious, ethical, and committed to the

environment and locally sourced products (Gelli et al. 2014). Integral to this approach are the establishment of student-run gardens, with the technical and theoretical support of universities, to stimulate eco-consciousness in the student body through contact with nature and courses that emphasize the project objective. This can stimulate healthy nutritional patterns and boost community preferences for locally-sourced agricultural products—especially those of small farms with less agrochemicals.

Food and nutritional education aims to improve eating habits in the medium and long term, and are related to representations about food, knowledge, attitudes and values (Zancul 2008). With children spending many hours per day in school, being repeatedly exposed to healthy eating in childhood can often become retained habits in adulthood. A healthy diet is one that provides all needed nutrients, with the right proportion and enough variety (Dixey et al. 1999). In this respect, the role of universities as promoters of sustainable development and holders of expertise in the scientific sphere is evident, through the dissemination of university projects aimed at the welfare of society and harmonious development with nature. In this context, the project *Horta Escolar* was developed by the University of Southern Santa Catarina (UNISUL), Brazil, seeking to encourage active interaction of primary school students (age range: 6–12 years) with the environment and involve university students from extension courses, especially agronomy, in providing technical guidance to children participating in the project.

UNISUL, founded in 1964, is a community university established by the municipal government of Tubarão, Santa Catarina, which aims to promote education, science, culture, sustainable community and social development with the creation and diffusion of technology, primarily in the region in which it is located, through a series of projects related to growth and local capacity building, aiming at a more sustainable future.

2 Methods

This study adopted qualitative methodological procedures. According Lüdke and André (1986), qualitative study is rich in descriptive data, has an open and flexible plan, and places what is observed in context. At first, the work was characterized as exploratory, as it sought to examine different subjects that were part the University of Southern Santa Catarina's *Horta Escolar* Project.

Exploratory research involves reviewing literature, conducting interviews with people with practical experience in the chosen area, and analyzing examples that can further understanding. The methodology is also descriptive, and therefore has, as one objective, describing the performance of the school garden design experience.

According to Gil (1996), descriptive research aim to make a description of certain population characteristics or phenomenon. Within the qualitative methodology of the proposed project, a case study was selected to provide a study of

complex social phenomena and unstructured examination of real environments with multiple stakeholders (Yin 2005). The case study method can be translated as an empirical inquiry that "investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 2010, p. 39).

The *Horta Escolar* project was devised in two stages, the first one carried out from March to July 2015 as a pilot project at the Dehon School (age group 6–12 years old) and the and Agronomy training garden at the UNISUL campus in Tubarão, Santa Catarina, Brazil, and the second involving several public schools in the same aforementioned city.

The realization of learning workshops took place in order to generate knowledge in the children about the importance of growing food, as well as developing awareness of environmental preservation and creating social values, knowledge and actions aimed at sustainable development.

The workshops carried out with students of the Dehon School included preparing soil beds; collecting of soil; seeding trays and flower beds; construction of a worm farm; noting the importance of vegetation in the soil; seed collection; capturing insects and the types of plant damage they can cause; and transmission of nutrients in plants. Many of the outreach university students from undergraduate UNISUL courses were awarded scholarships either from the *Artigo 170* program of the Santa Catarina state government (financial resources for the granting of scholarships and research to economically disadvantaged students enrolled in undergraduate courses) or the *Programa de Auxílio ao Acadêmico Carente* (PROAAC) from UNISUL (scholarships for undergraduate students) were involved in conducting workshops with professors.

In order to promote the implementation of the project consistently, five steps were developed, which are described in detail below:

1. Two schools were selected to implement the project—this selection was based on the availability of space and resources, soil quality and weather conditions, as well as ease of access and security for students.
2. After the selection of the schools, the university contacted school directors to establish guidelines and select the teachers responsible for the gardens and serving as a point of contact with the university. It was the responsibility of the directors and responsible teachers to determine the location of the garden and select the student groups participating in the project, ensuring that it did not exceed the limit of 120 students per school.
3. After this stage, the university promoted lectures to raise student awareness of the importance of healthy eating, based on the daily consumption of vegetables. These lectures were given by 72 UNISUL outreach students.
4. The gardens were established. The UNISUL outreach students were involved at every stage, with classroom lectures and practice in the garden site. Students were instructed about the entire process, including picking appropriate locations, preparing the soil, composting with the use of household waste, choosing the right vegetables for the region, seedling production, making beds, planting, care

with water, insects and diseases, harvesting, and preparation of vegetables in order to encourage environmental awareness.
5. The completion of this phase of the project involved the preparation of a seminar involving directors, teachers, professors, and parents of students to discuss the learning acquired by the students throughout the project, as well as to encourage that the good eating habits promoted during the project would be maintained at home.

3 The Role of *Horta Escolar* Project for Engaging the Community for Sustainable Development

The *Horta Escolar* project was developed by UNISUL with the purpose of promoting environmental conservation with theoretical learning, practical experiences by educating students of different ages about the importance the environmental and nutrition. The project is a response to the demand of the local Tubarão community to provide support and education to schools by creating gardens within the school setting.

School gardens have increased student contact with nature while complementing school meals and encouraging a healthier family diet, in addition to expanding the traditional theoretical knowledge of subjects such as Chemistry, Physics, Biology and Mathematics, and, for practical learning, respect for the environment and exercising ethics, citizenship and responsibility.

The *Horta Escolar* project in its first phase took on the role of raising awareness among children that life depends on the environment, the environment depends on every inhabitant of this planet, and people can have a healthier diet in a simple and practical way. The project was implemented through the direct contact of students with the natural environment; establishing a study space for discovery and learning as an extracurricular activity; the teaching of planting techniques, soil management, and plant care with techniques for the protection of soil structure; development of environmental responsibility towards both biotic and abiotic systems; promoting social responsibility for group participation, encouraging respect for others and stimulating dialogue; creating a systematic exchange of information in the environmental context through observations, concrete actions, and practices that can be held in the school setting; promoting students to perceive the garden as a living space, where everything is linked together, providing sustainable production and supply of healthy food; strengthening the understanding of the importance of adequate nutrition for health; and providing of vegetables for school meals.

The results of the *Horta Escolar* Project can be observed by the university's involvement with the local community; the improvement in the socialization level of the students and development of specific skills; the increase in the level of hygiene in the school environment; awareness of the need for conservation of natural resources; the integration of cultural, social and ecological literacy;

encouraging an appreciation of farming and related professions; education and development of the concept of sustainability; and educated the students to become more environmentally conscious citizens.

4 *Horta Escolar* Project: Results and Challenges

The first stage of the project involved 48 students between 6 and 12 years old, divided into 3 different classes. The students from the full-time Dehon's School are expected to dedicate one part of the school day towards extracurricular activities, such as participation in outreach projects.

Seventy-two university outreach students participated in the project, including scholarship holders from *Artigo 170* and PROAAC undergraduate courses such as: Agronomy, Civil Engineering, Information Systems, Life Sciences, Social Communication, Physical Education, Pedagogy, and History, demonstrating the interdisciplinary aspect of the project. Supporting training materials were made available to the UNISUL outreach students via two meetings with the project heads. This training material was also the basis for the preparation of educational workshops. University outreach can be understood as the application of knowledge beyond classrooms and laboratories, meeting the demands of the public sector or the community in which the university is located through an interdisciplinary aspect (Paula 2013).

Learning workshops were held three times a week to consider a series of proposed topics and promote the socio-environmental awareness of students. The most attended workshops involved the preparation of planting sites, the importance of vegetation in the soil (Fig. 1), the capture of insects and the types of problems they cause in plants, construction of an earthworm farm, and soil types (Fig. 2).

Fig. 1 Workshop on the importance of vegetation cover

Fig. 2 Workshop on types of soil

After the practical workshop orientation, the UNISUL outreach students answered a survey encompassing the following topics: (i) academic performance—asking if their participation in the *Horta Escola* project contributed to improved academic performance and future employability; (ii) checking if the project benefited outreach students by providing a holistic education experience combining theory and practice; (iii) allotted time: confirming whether the outreach students had enough time provided to meet the needs of the project objectives; (iv) if expectations were met—verifying that the Horta Escolar project meet the expectations of the outreach student. Figure 3 shows the outreach students level of agreement with each question.

After analyzing the survey data from the outreach students, regarding academic performance, over 80 % said that the project has helped them to develop new skills in nutrition, environmental ethics, and responsibility through taking charge of the daily care of the garden. One of the UNISUL outreach students (outreach student #7) mentioned that "*it was very interesting and productive to interact with children from the school with questions of the gardens, crops, fruits, vegetables […] the project will be a very important achievement for the life of the children, since they will grow up already knowing a bit more about the importance of healthy eating*".

Relating to the relationship between theory and practice, all the students agree that the *Horta Escolar* Project provided visible benefits for a holistic education. Another outreach student (outreach student #4) commented that "*the project made it possible to understand that the knowledge acquired in the classroom can be*

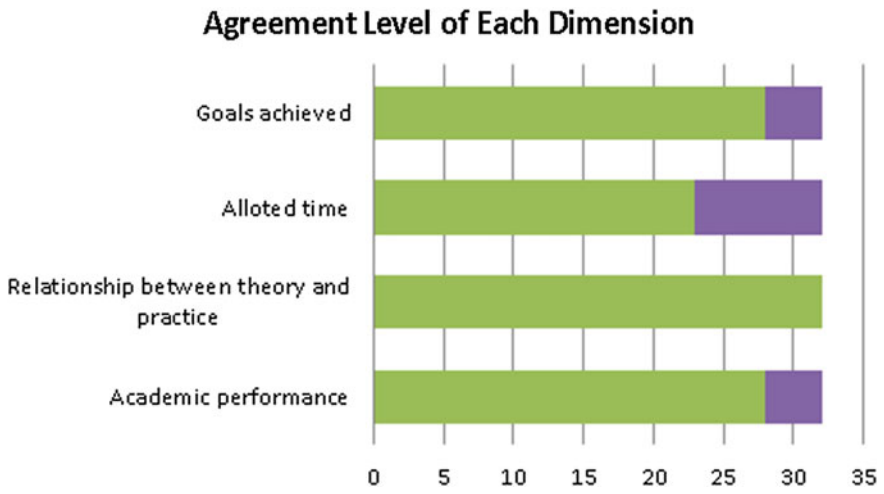

Fig. 3 Agreement level of each dimension

applied in reality. In the development of the Horta Escolar *project, knowledge and materials were studied in the classroom to then be applied in the gardens with the participation of children*".

Concerning time allotted, there was difficulty reconciling the schedules of outreach students with the *Horta Escolar* activities. Considering that many students work during the day to pay for their studies, it was difficult for some to be present during school hours in the practice gardens.

The final topic from the outreach student survey regarded if the project met their expectations, and 87 % of respondents agreed that it had done so. Those who did not have their expectations met said they hoped the project would be implemented in more schools or that the technical part worked on with the children was very simple. This type of information obtained from participants confirms the need to deepen and broaden the *Horta Escolar* Project. One participant (outreach student #8) mentioned that he "*expected more because it was a very simple practice*".

Importantly, the vast majority of expected results were achieved: there was the involvement of the university with the communities participating in the project; the children engaged with the project themes of environmental awareness and nutrition while developing new life skills; the school curriculum now incorporates ecological literacy, sustainability, and interrelationships with and responsibilities toward the environment; and, the importance of supporting local farming in the regional economy. Figure 4 shows the level of agreement of outreach students with the survey questions.

Figure 4 allows us to conclude that there is a correlation between the questions analyzed, revealing the positive impact of the project.

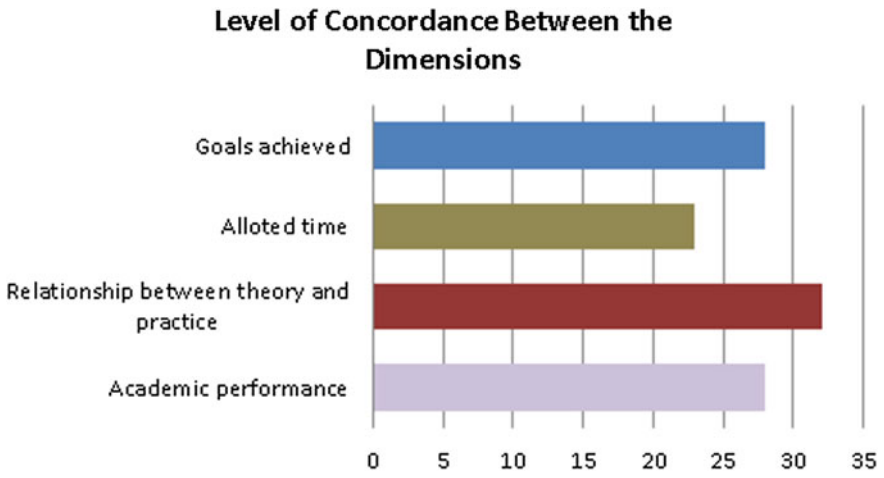

Fig. 4 Level of concordance between the dimensions

5 Conclusions

The *Horta Escolar* project under development at the University of Southern Santa Catarina, Brazil, involves outreach students from the university's undergraduate programs working with children 6–12 years old in the areas of environmental education and food. The results of the pilot project were analyzed in response to four questions placed to outreach students regarding improved academic performance, relationship between theory and practice, time allotted to the project, and expectations met.

It was possible to observe an alignment between theory and practice, stimulating learning and teaching. The creation of a school garden made it possible for the school to have a better awareness and appreciation about principles of organic gardening, soil management and insects, in addition to the planning, execution and maintenance of gardens. All practical activities chosen to carry out this project stimulated the curiosity of students, leading them to participate more effectively in the class.

Another aspect to be considered was the awareness of the outreach students and the schoolchildren about the importance of healthy eating and environmental preservation. Educational proposals like the school garden are extremely important in regards to breaking down some of the existing barriers between theory and practice in the environmental sustainability field. In addition, the inclusion of school gardens is an important tool in the instruction of natural sciences by inserting the topics of vegetable consumption and sustainable environmental awareness. Finally, the biggest gain can be attributed to the fact that outreach students have developed skills and abilities in awareness initiatives, and that environmental

conservation practices in the context of food production and healthy eating have been disseminated in school communities with a high capacity for resilience.

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Student Capital in Green Cities: Building University—Student—City Coalitions

Christine Willmore

Abstract

Bristol (UK) is European Green Capital 2015. University students form over ten per cent of the population, the two Universities. The University of Bristol and the University of the West of England and their Student Unions are running a major project, supported by catalyst funding from the Higher Education Funding Council for England, to engage students in the sustainability transformation of the city region of Bristol. This paper reports on the first phase of the project, its aims, the learning emerging, the support needs for large scale transformative coalitions and the impacts upon all those involved, at the end of the first academic year of the project (2014/15). This project aims to overcome resource questions and develop transferable models of student engagement for sustainability with the cities in which they live. It suggests ways in which a re-visioning of student volunteering may mobilise more students and community partners. The project is testing different ways for securing student engagement in transforming sustainability activity in the city region—in partnership with the business, public and voluntary sectors. It is committed to delivering a transformational change in student engagement and aims to deliver 100,000 extra hours of student activity for sustainability in the community in 2015, to skill students as change agents, to help community change and to link student activism with more formal aspects of their education. It aims to develop a 'challenge shop' approach to help sustain the work of partnership building beyond the 2015 project so as to ensure students and the community continue to be able to find productive ways to work together for sustainability. It is

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predicated on coproduction models of project design and engages students, staff and other citizens as partners each bringing insight to the activities, and is adopting an action research approach. Much has been written about student engagement but less has been written about the different approaches to linking formal and informal student activity. The study makes a unique contribution in that different approaches are being tested simultaneously.

Keywords
Education · Sustainable development · Student-Community engagement · Volunteering · Student projects · University · City region engagement · Open innovation · Experimentalist governance

1 Introduction

Stephens et al. (2008) considered the potential for higher education institutions to act as change agents. This chapter reports on a project designed to explore the capacity for universities and students unions to work together with city leaders, businesses and the community to mobilise students as change agents to transform their city—region. The Bristol Student Capital: Green Capital Project funded through £250,000 Higher Education Funding Council for England (HEFCE) Catalyst Fund Award, is a completely collaborative project between Bristol University and the University of the West of England, Bristol and their student unions working with the city and communities of the city region of Bristol to harness students as participants in sustainability transformation in the city region. It is overseen by a steering group of staff and students from the universities and student unions, as equal partners, bringing together students, professional services staff (including placement and public engagement staff), estates and academics and embedded in existing structures to maximise legacy prospects. The project is the combined effort of a large team at both institutions, but the author takes responsibility for the views expressed in this chapter as personal reflections not a formal project report.

2 Place Based Innovation

Fundamental to the research and its methodology is the concept that innovation needs to be place based (Hambleton 2015), expanded by Stephens et al. (2008) as five questions—the sustainabiliy challenges of the region, financing, institutional organisation, democratic (and this paper would add governance) processes and communication and interaction. To this our work would add aspirational alignment. The articulation of innovation and change depends upon particular contexts. This does not mean that lessons cannot be learnt for use elsewhere, but as a starting point is clear that the precise development and articulation of change leadership is context

dependent. The work is located within the wider global movement for city and regional led sustainability transformation—but harnesses the particular focus on Bristol being European Green Capital in 2015, and the stage of development reflected in that designation to engage students of two universities in that journey. The engagement of Universities and students in previous Green Capital cities has varied considerably. Universities are an often neglected resource in city transformation: their impact being a product of presence rather than a deliberately nurtured participatory impact (Goddard and Vallance 2013) and certainly work looking at the role of Universities in their cities often overlooks the distinct role and agency of students themselves as change agents. The language of the 'engaged university' has a long history, and particularly in the USA there is a long history of institutional engagement in building more sustainable cities and city regions (see for example Kania and Kramer 2011; Ozawa 2004). In Europe this has often focussed either on technology or economic or cultural development activity e.g. D'Auria (2001). Few UK initiatives have sought to build whole institution and whole city-region initiatives focused on building an inclusive and sustainable city—and few have sought to use student volunteering as the focal point for such work. There is a body of literature about the contribution of RCEs to regional activity for sustainability (e.g. Mader et al. 2008; Tormey et al. 2008), but again the focus is not upon student engagement. A number of discipline based articles report on the development of specific engagements or themes, but not whole institution repositioning.

3 Rethinking Student Volunteering

Student volunteering has a long history. Brewis (2014) illustrates the way in which trends in student engagement reflect wider social changes, so for example she documents how, as young people became increasingly engaged in political campaigning in the nineteen sixties, student volunteering moved from service and fundraising to what became known as 'Student Community Action'. SCA aligned practical action with campaigning to address the causes of social inequalities. It transformed student volunteering in response to a changed student understanding of their role in the world. Bristol University was one of the first to establish a Student Community Action group. Fifty years on, students are once again re-interpreting their role. A key question being addressed in the Project is—what is the best way to frame student volunteering for the next generation of students?

A National Co-ordinating Centre for Public Engagement 2009 initiative sought to 'galvanise a step change in the quantity and quality of student volunteering in higher education', to recognise the value of volunteering and increase capacity through strategic co-operation (Squirrell 2009). The Project seeks to use the lessons from that work, and has at its heart the notion that the articulation of a new generational rationale to underpin that engagement can be seen in sustainability transformation through large-scale mobilisation. Even in the early stages of the Project, there is some evidence that creating a new vision can inspire and motivate a

new generation of students. That uniting vision, in the project considered in this paper is the notion of students committing 100,000 hours of volunteering a year to help transform their city towards a sustainable city. It seeks to articulate how each individual journey is located in a bigger journey, using an open innovation and experimentalist approach to building a diverse social networked model. This weaves together the myriad different initiatives and interests individual students are pursuing alongside formal opportunities to create a greater whole. Student engagement requires processes through which they can engage but also a visible weave of their diverse activities, to understand the cumulative impact of their engagement, provide examples to encourage others but to link those individual engagements into a greater whole. This networked approach with its strong cumulative emphasis has the potential to re-articulating student volunteering.

A number of emerging issues have combined to increase the pressure for and opportunity for a re-positioning of student–community engagement, and to place sustainability at the heart of the student-community relationship. Some are England specific, others wider:

1. Higher Education is itself changing
    a. Increased student numbers offering opportunities to transform the scale of ambition of student engagement, in particular through the changed role of students in the population profile of cities.
    b. An increasing interest by Universities in the holistic student experience, bridging informal and formal learning opportunities, as a result of competition between higher education institutions in student recruitment.
    c. An increased emphasis upon 'impact' in relation to research quality during the recent UK Research Excellence Framework process, leading to a growing academic interest in engagement and impact.
    d. A rethinking of the concept of the Anglo-Saxon University and whether the concept of 'the graduate' connotes more than academic qualifications—effectively a tentative recognition of the German concept of Bildung.
2. Changes in the approach of students
    a. An alienation of young people from traditional political movements with a simultaneous growth in student awareness of global challenges and the centrality of sustainability.
    b. An increased focus upon employability as a result of rises in the cost of education, notably in England both in the growing need for employment during studies and concern about employability after graduation.
    c. A growing student demand for opportunities to engage with sustainability (Drayson et al. 2014) for reasons of principle and employability.
    d. A growing recognition amongst students of the importance of 'change maker' skills.
    e. A networked age, in which social and informal media communication have largely replaced hierarchies in the way students communicate and explore the world and in the way partnerships can emerge and develop.

3. Changes in the way cities operate as a result of technological and social networking, public sector resource constraints and the reframing of core debates as a result of key global challenges.
4. Changes in global thinking about sustainability education, in particular the need to focus upon whole institution approaches identified by UNESCO at the end of the Decade of Education for Sustainability (UNESCO 2014).
5. The success of initiatives such as the UK National Union of Students, Student Green Fund Project 2013–15 (NUS 2014).

The biggest single sustainability impact of a University is its students—the graduates who leave each year with a lifetime of global footprint ahead of them:

> It is worth noting that the destruction of the planet is not the work of ignorant people. Rather it is largely the results of work by people with BAs, BScs, LLBs, MBAs, and PhDs … Education can equip people to be more effective vandals of the earth. If one listens carefully, it may even be possible to hear the Creation groan every year in late May when another batch of smart, degreeholding, but ecologically illiterate, Homo sapiens who are eager to succeed are launched into the biosphere (Orr 1991).

Rather than seeing this as a problem, it points to a massive opportunity for making an impact by enabling students to learn to tread more lightly and to take that with them into their lives after University. The experiences that enable students to develop a lighter footprint are also ones that provide the opportunity for change in the wider community by mobilising the agency of individual students. Critically these need to engage a sense of place, so that the footprint is located in a place, not uniquely, but as a condition of engagement in future places as students travel.

4 The Project

The University of Bristol is an internationally recognised research intensive University located in the centre of the city. The University of the West of England, Bristol is a modern University on three sites around the city. Between them they have 48,000 students—over ten per cent of the population of the city.

Bristol is the first UK city to win the designation of European Green Capital, a title it holds for 2015. The Universities were central to Bristol winning that status. The City Mayor was strongly supportive of a project conceived by students and staff at the two Universities to deliver a step change in the role of students in the city's sustainability agenda as part of that. Both unions already did significant work engaging their students at their respective Universities but the universities and unions were keen to take this a step further to use the focus of Green Capital to transform the impact of student engagement with the wider community.

The project aims to:

- Work collaboratively to synergise, build on and enhance existing curricular and extra curricular activity and develop and deliver new and highly effective

models enabling a larger cross-section of students to engage in sustainability action in the civic, business and voluntary sectors.
- Demonstrate the capacity for students to play a transformative role in the city, civic, business and community organisations and in the relationships between these sectors and Universities.
- Capture the imagination of city-leaders, businesses, communities, policy-makers and Universities and inspire open debate about the most effective models of engaged learning for transforming sustainability literacy and scaling up the degree to which cities benefit from the sustainability creativity of their students.
- Transform the city's understanding of the role of students in transitioning the city and students' understanding of what it is to live in the city and live sustainably.

The project is predicated on a hypothesis that engagement can be at once transformative for students and their education and also beneficial to the city and its communities. The role of engaged activity for learning has been well documented, see the literature overview in López (2013). The focus of this paper is upon the community outcomes. 'Sustainability' for this project embraces social, cultural, economic and environmental issues, taking the wide UNESCO definition of education for sustainability (UNESCO 2012), seeing sustainability as integrative. This aligns to the Bristol civic vision of an inclusive sustainable city.

The project does not lay claim to universality in its methodology or approach; indeed one of its conceptual underpinnings is a belief that place matters: that solutions are contextual, but it does test the question of what successful large scale student mobilisation might look like. The project asks:

- How can University students create and sustain large-scale student community engagement for sustainability?
- What are the impacts—on students, institutions, and the wider community?
- Who is best placed to mobilise students? What are the challenges?
- How can we best support holistic learning?

The project embraces volunteering in the informal curriculum, student research projects, placements and paid internships, aiming to align all of these opportunities for engagement. The routes offer conceptually different opportunities—placements and internships tend to offer students the opportunity to work on someone else's project, student research projects offer students an opportunity to work with partnership to co-design the question and methodology, volunteering can be about the creation and leadership of projects, co-creation or working on other's project. For some students volunteering will be the best route, others will want or need paid internships, others will study in areas where placements or research projects are an opportunity. Some will develop their own ideas; others will want to work on a project already underway. This project engages all these routes—seeing them as complimentary and essential to providing a diversity of opportunity for students and for community partners, responsive to the needs of both. An early finding from the project is that students, staff and partners are not necessarily aware of the range of

potential routes to engagement, and their respective merits. The Project aims to provide an umbrella under which these can flourish. Rather than a structured approach it offers a networked cloud of narratives, through which students can navigate to identify their own engagements, and through which the community can identify new partnership opportunities. Providing a single umbrella for partnerships, offers an opportunity to promote partnership and then work with individuals and groups to identify the best framing of that relationship—rather than students, staff and partners seeking to shoe-horn their aspiration into the first partnership vehicle they encounter. It also enables the concept and visibility of engagement to rise above individual engagement activities and therefore transcend the natural life cycle of any one particular project. Individual projects are expected to come and go naturally, but within a continuing organic whole. In this chapter, the word 'volunteering' is used as shorthand for this diverse range of engagement opportunities.

To assist in making choices about how to frame initiatives in the future, the project seeks to understand more about the differential penetration and impact of University curriculum based initiatives, Student Union initiatives and third party initiatives. It is looking at which sources of initiative have most impact, whether there are differences by student or discipline characteristics and whether there are any patterns in how and to whom different activity types appeal (paid and unpaid), different facets of sustainability, methodologies, locations, and partner types (civic, private and voluntary sector).

The Project is predicated on coproduction models of project design and engages students, staff and other citizens as partners each bringing insight to the activities (see Trencher et al. 2014). It is adopting an action research approach, combining concepts derived from techniques of open innovation (Chesborough 2003) and experimentalist governance. Sustainability necessitates the development of a responsible and responsive organism with distributed ownership, responsibility and autonomy. That distributed ownership and autonomy is difficult to achieve through hierarchic models of leadership, so experimentalist governance approaches are being used to create and protect that space and foster innovation.

To develop this sort of open weave there is a need for shared language as a means of mapping initiatives and fostering student development. The project is testing a number of ways of articulating this, one of which is the approach developed by Bristol Student Union (Watts and Tweddell 2015), which adapts Anderson and Krathwohl's revision of Bloom's taxonomy (Anderson and Krathwhol 2001). The Bristol approach maps four steps:

- Learning—empowering students to become change makers in their curriculum and understand the need for action
- Act—developing positive environmental behaviour in the individual in their own lives e.g. recycling

But then makes explicit the further steps looking beyond an individual's own life:

- Engage—giving opportunities for students to volunteer and contribute to sustainability in the community
- Create—supporting other students to make their own green ideas a reality.

In its use so far, it seems to offer a strong language through which to enable students to link their own individual skills and career focus with the rationale for wider action and to understand a developmental approach to their own choices.

The project is also testing the role of threshold awards in surfacing and celebrating student action. Student Green Capital Change Maker Awards have been developed, for which students need to have participated in city engagement for sustainability, and for the highest level need to have communicated with others about what they have done—through social media, presentations, or otherwise. This emphasis upon communication is partly instrumental—to widen awareness and bring others into the project—but is also a fundamental part of building from individual actions to a movement for change, where sustainability engagement is normative. These are open to all who demonstrate sufficient engagement and as such encourage people to surface their own activity. In one sense they are similar to the 'added value' awards commonly run by careers services but these have a sustainability focus and do not have the programmatic features common with added value awards. These awards are bringing into the light initiatives by students or groups of students that have not emerged from formal structures. It provides a rational for students to share with the institutions and city their own, amazing innovation. One of the features of the changed context of volunteering is the growing ability for initiatives to spring up outwith formal structures using social media to build communities of interest. The project does not want to manage or control those initiatives in any way—but wants to surface them as part of the wider whole. Only one Award cycle has been completed, so it is too early to reach conclusions, but early indications suggest this is has potential—some of the best examples of student change-making have surfaced through this process and would not have emerged through traditional routes.

Earlier work by some of those involved in this project (Willmore and Tweddell 2015) set out four key challenges for whole institution movements for student engagement:

1. Creating Institutional Space for reflective action
2. Articulating Learning and Methodological Frameworks
3. Skills framework
4. Relationships

The project is testing that analysis, and possible solutions to some of the challenges, not merely at an institutional level, but at a pan-institutional level, and across the formal and informal curriculum. As the project progresses further reports will explore the application of that framework to the project and the methodological lessons learnt.

The resource costs of sustaining long term relationships to underpin student engagement is fundamental to the project ensuring legacy mechanisms are developed and tested which to ensure the momentum and links continue beyond the project. The project's headline quantitive objective is to deliver over 100,000 h of student activity for sustainability in the city in 2015 but it is essential for the project to develop and embed a legacy tool for supporting relationships and fostering new ones so students and the community continue to be able to find productive ways to work together for sustainability, not just in 2015 but every year. The model being developed is an on line 'challenge shop'. A first need is to develop a clear contact point to facilitate students, and city, business and community partners finding each other. Universities are complex institutions. For potential community partners it can be difficult to find the right contacts, particularly given the potential power inequalities in play, and the different framing of questions. But equally for students it can be difficult to see what opportunities exist. It is easy for students to engage with the opportunities they trip over, rather than being able to make informed choices about which opportunity to pursue. However the aspiration extends beyond a contact point, and aims to build a dynamic cloud of narratives in which students and community partners post stories about their collaborations, to encourage new ideas, as well as brokering new projects—creating a virtual location that remains dynamic and fluid. Community groups who have not yet worked with students do not necessarily know what is possible; equally students don't know the range of opportunities that might exist. Stories of success foster awareness and confidence in the process. The project has evaluated existing tools and is now developing an interface that reflects the particular challenges of university—community interactions, which will be tested in the second phase of the project and will, it is hoped be sufficiently flexible to be adapted for use elsewhere.

4.1 A Sense of Place: Bristol

Place matters: Universities and the individuals who comprise a University are part of a network of communities, some geographic some social or economic. The position of the institution and the individuals within that network offer opportunities to support change in diverse ways.

The project does not problematize cities as inherently unsustainable or as passive victims of external forces, but sees them as repositories of considerable power through connecting individuals and as having the potential for global impact through city networks. It is estimated (UN 2014) that 54 % of the world's population live in urban areas, and that by 2050 this will rise to 66 %. In Europe this is already 73 % and in the UK over 90 %. So urban areas **have** to play a role in advancing sustainable development, but many are going further and becoming global leaders of sustainability innovation. Bristol, with 450,000 residents for example was part of the C40 Cities Climate Leadership Group network of cities

making a climate change pledge at COP21 in Paris in November 2015, outwith inter-governmental agreements.

Bristol is also not alone in finding its University student population forms over ten per cent of the city population. For many UK cities, higher education is a leading determinant of employment, investment and local spending power. Universities are also major resource sinks in terms of consuming housing capacity, transport capacity and affecting retail and leisure sector profiles. Students can readily be problematized as the source of social disruption, forcing up housing prices and overriding the needs of long term residents. However the same reasons that generate these pressures also provide a massive opportunity. If ten per cent of a city's population are students, any major change in the city will need to engage those students—but equally, engagement of those students can itself generate considerable momentum for change. It is not yet common for cities and their students to collaborate on sustainability transformation projects and in particular to recognise the agency and potential of students. Too often cities still students are seen as individually transient, rather than seeing the collective permanence and significance of a student population despite the individual transience within that.

Many cities may identify with these features. There are however features of Bristol as a place which impact upon the project. The award of European Green Capital status undoubtedly offers a unique opportunity, not immediately replicable, but that award reflects other distinctive features of Bristol on its journey to sustainability—for example the concentration of major sustainability organisations in Bristol. It is a city with a directly elected Mayor and a vision of an inclusive sustainable city. It has a strong culture of sustainability and an experimentalist approach to governance, in which innovation and experimentation flourish. Bristol as a city can be characterised, as a 'self-organising network'—a complex community in which culture, values and inter connections can drive change outwith central dictat. Alongside traditional democratic structures, it has a series of articulate and well-networked community organisations. A crucial example of that for this study is the Bristol Green Partnership, which brings together over 800 organisations in the city working through sixteen theme groups to develop new initiatives and share experiences. They work in a dynamic manner, and are increasingly experienced in working with a vast array of organisations and individuals at all levels, bridging the civic, private and community sectors and building a complex system of trust and partnership.

The city approach to sustainability is predicated upon harnessing the power of such networks. In an earlier publication the author explored the role of experimentalist governance in delivering sustainability change (Willmore 2015). Experimentalist governance posits that local experiments not merely do, but should, be the key drivers of improvement, with innovation and action at the lowest level (Zeitlin and Sabel 2011; Rhodes 1996). Shared goals drive change and provide a context for evolving new goals, solutions and strategies. The process is multi-centered and mutually adjusting. Von Hohmeyer (2010) considers this sort of approach as particularly suitable for sustainability challenges where solutions require behaviour change by front line stakeholders, problems are highly complex

with diffuse sources, and where there would be weak enforcement mechanisms for top down solutions.

That context is essential to the methodology of the project, and helps to address the challenges of embedded power inequalities (Down and Nurse 2007). They document the risk of treating community partners as inferior, rather than holders of a different expertise and the importance of de-centring the University. By focussing upon the role of students within these community networks, there are opportunities not only to address those risks (students are not perceived as having quite as much inherent power and privilege as the institutions themselves), but potentially to go further and change perception of the institutions themselves both internally and externally.

5 Some Initial Findings

The focus of the project is the calendar year of 2015, spread across two academic years, but with a strong legacy commitment. This initial chapter can only outline some of the emerging narratives that are helping shape future phases.

In simple numeric terms the project is delivering its pledge of 100,000 hours of student action in Bristol with a direct economic value of over £1 million. Some initial experiences have been surprising. The enthusiasm and commitment from students has been a positive surprise, with students taking unprompted action to stimulate interest in their peers. It is proving a particularly rich experience for international students, often harder to engage in extra-curricular activity, As one international student in a phase one-student satisfaction survey, after undertaking a massive 170 hours of volunteering with 14 different organisations said '*it made me feel I belonged*'. This is underpinned by initial data showing that 55 % of the participants in University of Bristol Student Union work in phase 1 are non-UK based students. These responses have identified the relationship between sustainability engagement and the depth of a student's sense of belonging as a matter for exploration in the next phase of the work and a potential unexpected benefit.

The vibrant and reciprocal nature of the collaboration has developed an independence from the project leadership. Links developed initially as ways for students to find engagement opportunities have rapidly become dynamic mutually supportive relationships between community groups and students, so for example sustainability networks across the city are now supporting students in their campaigning to secure University divestment from fossil fuels.

Students from **every** discipline represented across the two Universities have offered their skills and enthusiasm to support NGOs, schools, voluntary groups and SMEs to address sustainability challenges. So far over 10,000 students at Bristol University alone have participated in sustainability events in 2014/15. This is reaching over half the student population. Students have worked in companies to conduct waste and energy audits and to develop sustainability strategies; developed business plans for NGOS; worked to develop the use of Green Impact in local GP

surgeries; worked with groups as diverse as a city farm, city council energy department, energy co-ops, neighbourhood partnerships, youth empowerment organisations and those working with teenage parents. Some projects have been large-scale student activities e.g. students have spent hundreds of hours helping run the Bristol branch of FoodCycle. The work has stretched across the breadth of sustainability, including student led projects with national impact, e.g. one medical student set up a group to design training for doctors (GPs) on spotting signs of human trafficking, modern day slavery and sex work. 57 Bristol GPs were trained using her work and the Department for Health are now using her research to decide how the National Health Service should respond to human trafficking.

Although only at the end of the first phase of the project, there are some very clear initial qualitative indications, to be further tested during phase two The first is the extent to which the provision of a light touch whole institution umbrella for the activity has transformed the visibility, penetration and scale of engagement in terms of student, community and institutional commitment. Leadership for transformation in this context has facilitated the rapid development of a complex array of relationships, avoiding the dependence upon the presence of particular individuals.

The networked approach under a clear umbrella in the first phase has delivered a much higher (and more diverse) profile for the Universities' commitment to community engagement enabling the Universities to reach sectors and areas not previously engaged. Partners have enjoyed the two way process of interacting with the Universities, opening up new partnership opportunities for academics as well as students. It has captured imaginations and transformed perceptions of what students can achieve both within the University and externally. Senior management is highly engaged, and is now using examples of student sustainability action in the community on public platforms. This is of inestimable value in terms of opening doors for student and academic collaboration into the future, with new organisations coming forward to inquire about partnership working and invitations to fora where partnerships can be forged. More students have a stronger grounding in sustainability action and understand how what they are doing fits into the wider picture of developing a sustainable city. There is already of a changed perception of the impact of student engagement amongst city leaders, businesses and the wider community.

It is changing the perception of students, but there is some evidence the change is going further and affecting the perception of the Universities in the city. As one partner said:

> It has been fantastic to work with the University as well; lots of people in this area don't go on to University or have any connections. It has really changed our perceptions.

An unexpected challenge that has emerged in the first phase of the project, and will affect the methodology for phase two is an emerging issue of community perceptions of the capacity of students. Seventy-five years ago, people the age of current students were military officers, responsible for other people's lives, leading teams in the midst of global conflict. There is no evidence that today's twenty year olds are any less capable—but there is evidence of a need to rebuild public

awareness of that massive potential. Initial thinking by some community partners when asked about student engagement is to think of very limited roles and to express concern about the perceived levels of supervision and training needed for even the most constrained volunteering. This is in distinct contrast with the levels of satisfaction expressed by community partners after they have worked in partnership with students, as one NGO involved in a project in which students worked on a new business plan for the NGO said

> We felt through conversations and meetings they really got to understand our business and produced a brilliant business plan that is really going to help us going forward.

The challenge shop cloud of narratives was always seen as important to the project, but is now all the more so, to ensure the positive experience of those who have engaged is shared.

It has proven possible, so far, to avoid some of the other challenges anticipated in Willmore and Tweddell's work, for example they postulated that ethics approval and conflicts of timescale and outcome expectations could be a barrier for engaged research projects in the formal curriculum. These remain a risk, but so far there is no shortage of projects that do not give rise to these issues. Where partners have ideas which give rise to potential conflicts of timescale, outcome expectations or ethical questions, the whole institution approach, enables partners to be redirected to other vehicles such as volunteering, internships and placements better suited to their needs, without discontinuities of relationship. To Universities whether a student's work is curricular or not is structurally significant but to the community partner it is irrelevant. The holistic approach to engagement via the '100,000 hours' umbrella is itself a tool to reduce problems.

6 Conclusion

There are further phases in the project, and a full evaluation will follow these next stages, but the achievements of the first phase have already yielded some lessons. Through a cross university, pan city engagement it has increased visibility and facilitated brokerage of new relationships. Critically, it is fostering a culture change in which participating in sustainability action beyond the University is seen as normative and which, in turn, has the potential to contribute to transforming the city by harnessing this energy.

The project has established a rapid momentum, achieving project targets and a wider change profile far sooner than was expected. The use of a networked model for mapping and promoting participation, and the use of experimentalist models of governance have enabled the project to adapt rapidly and work within the Bristol Green Partnership of over 850 organisations. It provisionally offers strong evidence for the potential efficacy of whole institution and whole city approaches to student—community partnerships. It may be that the speed of attaining these early successes of this project are the product of a particular place and time—and in particular European Green Capital status with its associated momentum, and can only offer a

case study in a particular place and time. However, these particularities may determine the speed of change and preparedness of the wider community and may be less significant to the fundamental lesson that whole institution—city wide approaches to the role of students as catalysts in city sustainability transformation are capable of being constructed, are less costly than might be feared, can rapidly deliver more than the sum of their constituent parts and offer new articulations for student volunteering—providing both the institution(s) and community are prepared to be flexible.

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Author Biography

Christine Willmore qualified and practiced as a barrister specializing in environmental and planning matters, in parallel with her academic work. She has spent 35 years teaching and researching in sustainability and law, and has been actively engagement in civil society throughout that time. She is currently UK Environmental Convenor for the Society of Legal Scholars. She is academic lead on education for sustainability at Bristol University, and established its Green Academy project work, working closely with estates, Bristol Student Union and the Cabot Research Institute (of which she is a member). She has been part of a number of award winning sustainability projects in the University and amongst other things currently directs the award winning Sustainable Development open unit available to all undergraduates. A feature of her work has been building bridges between formal and informal curriculum learning to achieve holistic educational transitions. The project that forms the subject of this paper is funded by HEFCE. She leads the University of Bristol team, with James Longhurst who leads the UWE team. She would like to thank all of the students and staff who have worked so hard to secure funding for the project and begun to help transition the city they and she live in.

ZukunftGestalten@HM—Future City. Transdisciplinary Approach Combining Higher Education for Sustainable Development and Designing the Future of the City of Munich in an Urban Real Lab Case

Ralf Isenmann, Sascha Zinn, Klaus Kreulich and Andreas Peter

Abstract

This contribution describes the innovative course format "ZukunftGestalten@HM—Future City" at the Munich University of Applied Sciences (MUAS), including its unique features from a higher educational perspective for sustainable development (ESD). The features that make this innovative course format challenging and unique compared to other formats are that it provides an

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excellent example of a transdisciplinary approach in ESD, combining ESD on the one hand and designing the future of the city of Munich in an urban real lab case on the other. Based on these certain characteristics we call "ZukunftGestalten@HM—Future City" as the flagship course within the various ESD formats offered at MUAS. It is an outcome of the BMBF-project "Future proof" (German: Für die Zukunft gerüstet, www.hm.edu/lehre/zukunft/, grant no. 01PL11025), funded by the German Federal Ministry of Education and Research (www.bmbf.de/en/). We view transdisciplinarity as a principle of how to approach problems from an academic perspective. It is not a feature of an issue itself, rather a way of how to deal with current challenges or relevant problems resp. according to academic standards. The often applied scientific "closed shop procedure" of problem solving mainly within universities, classrooms, courses, and project groups is overcome. Interested parties outside universities and academia are actively involved. The scope in the summer term 2015 has been to investigate how future cities may look like in general, and how the city of Munich should be developed in terms of sustainability more specifically. This topic reflects the issue of the science year 2015, dedicated to the future of the city (www.wissenschaftsjahr-zukunftsstadt.de) and promoted by the Federal Ministry of Education and Research. The development of cities is a critical driver for sustainable development, and hence their efforts to provide sustainability solutions merit greater effort. As a tangible, local, and real life example we further focused to an ongoing urban planning project of the city of Munich, co-operating with the Department of Urban Planning and Building Regulation, Unit "Population, Housing and PERSPECTIVE MUNICH" of the City of Munich. The specific goal and certain motivation for the City of Munich was to get innovative, fresh, and unorthodox approaches and to receive new insights on how to develop the certain field of action (German: Handlungsraum) in the North of Munich: "Zwischen Milbertshofen und Freimann. Wohnen, Arbeiten, Bildung und Sport im Münchner Norden" (Landeshauptstadt München 2013). The experiences made and the insights gained from "ZukunftGestalten@HM—Future City" may fuel public discourse, initiate discussion and promote dialogue. In particular "ZukunftGestalten@HM—Future City" inspires traditional planning procedures of the Department of Urban Planning/Urban Development, City of Munich, and it may have further impact for strategic urban planning and development projects.

Keywords

City of munich · Competencies for sustainable development · Education for sustainable development (ESD) · Higher education · Learning · Munich University of Applied Sciences (MUAS) · Real laboratory (Real Lab) · Transdisciplinarity · Urban planning · ZukunftGestalten@HM

1 Introduction to Sustainability at Universities

Sustainability—as the short form of sustainable development—could be incorporated through various forms in higher education institutions, academic curricula, and students' day life (UE4SD 2014; Leal Filho 2012; Gonçalves et al. 2012; Starik et al. 2010; Leal Filho 2009). Among others, different organizational levels offer a vast of opportunities where ESD could be implemented (Isenmann and Zinn 2015a). Opportunities include: joint courses of a network of universities bridging the limits of just one entity, university-wide courses typically offered by a central faculty or department specialized for general/interdisciplinary studies, joint courses provided by a number of co-operating faculties or departments, and customized courses offered by certain faculties or departments. More and more universities are being aware of these emerging opportunities and hence they are developing a clear and convincing program focused on ESD (UE4SD 2014). Further to different organizational levels, the four principles of disciplinarity open another window of opportunities for ESD (Isenmann 1999; Isenmann and Zollner 2014):

- Monodisciplinarity stands for a perspective where sustainability issues are studied from a single and standalone discipline. For example, the faculty of business administration offers courses on "sustainability management" highlighting the economic point of view and emphasizing business opportunities.
- Multidisciplinarity describes a method of approaching sustainability on the background of few disciplines just added but without any linkages and substantial exchange. Lecture series, perhaps on climate change or on "Energiewende" are examples where different faculties shed some light to a common problem.
- Interdisciplinarity additionally reflects differences in scientific disciplines like specific foci, certain methodologies, and heterogeneous basic assumptions. For interdisciplinarity, these scientific basics are explicitly reflected and taken into account.
- Probably the most ambitious and challenging effort however is a transdisciplinary approach (Jandrić 2014; Jahn et al. 2012; Scholz et al. 2006; Bergmann et al. 2005; Funtowicz and Ravetz 1993). Transdisciplinarity is characterized as the latter, but in contrast to interdisciplinarity the academic "closed shop procedure" of scientific problem solving is overcome. Interested parties outside universities and academia are actively involved. Stakeholders from the "Lebenswelt" (E. Husserl), e.g. from local communities, municipalities, and NGOs (non-governmental organizations) take an active role, share their views and exchange knowledge along the whole problem solving process. Typically the problems considered in transdisciplinary approaches originate from urgent societal challenges. These challenges often have a regional bias and are embedded as a part in an ongoing local agenda process like urban planning, mobility and infrastructure development, housing, energy provision, demographic change or any other strategic complex project of a public-private partnership relevant in terms of sustainability. In that sense ESD needs to be studied as a holistic effort, addressing a broad range of learning content and

outcomes, including pedagogy, and finally empowering to societal transformation.

Against the background of the broader international context of sustainable transition management (Grin et al. 2010; SEI 2002) and the ongoing worldwide discourse to ESD, such a transdisciplinary approach is currently labeled as so called "real laboratory—short: real lab" (RNE 2014; Schneidewind 2014; NPZ 2014). From an urban planning and development perspective it could also be termed as "urban lab" (Schneidewind 2014; Fraunhofer 2014). No matter which term or label is actually used and which perspective is emphasized, the common underlying motivation for transdisciplinarity and applying "urban real labs" for ESD is rooted in the growing international recognition that universities are explicitly taking responsibility for their outstanding role within society, particular in contributing to sustainable development (Beynaghi et al. 2014; UNESCO 2014; Leal Filho 2011). Consequently universities have also begun reporting on their sustainability actions and future plans (Isenmann and Zinn 2015b; Sassen et al. 2014; Müller-Christ et al. 2009).

This contribution describes the innovative course format "ZukunftGestalten@HM—Future City" at MUAS. The scope in the summer term 2015 has been to investigate how future cities may look like in general, and how the city of Munich should be developed in terms of sustainability more specifically. This topic reflects the issue of the science year 2015, dedicated to the future of the city and promoted by the German Federal Ministry of Education and Research (BMBF 2015). The development of cities is a critical driver for sustainable development, and hence their efforts to provide sustainability solutions merit greater effort. As a tangible, local, and real life example we had focused to an ongoing urban planning project of the city of Munich. The goal was to provide fresh and unorthodox approaches and to deliver new insights on how to develop the certain field of action (German: Handlungsraum) in the North of Munich: "Zwischen Milbertshofen und Freimann. Wohnen, Arbeiten, Bildung und Sport im Münchner Norden" (Landeshauptstadt München 2013). The experiences made and the insights gained from "ZukunftGestalten@HM—Future City" fuel public discourse, initiate discussion and promote dialogue. In particular "ZukunftGestalten@HM—Future City" inspires traditional planning procedures of the Department of Urban Planning/Urban Development, City of Munich, and it may have further impact for strategic urban planning and development projects.

As the overall goal, the flagship course "ZukunftGestalten@HM—Future City" provides an excellent example of a transdisciplinary approach in ESD. The course combines ESD on the one hand and designing the future of the city of Munich in an urban real lab case on the other.

- We firstly introduce the institutional embeddedness of the transdisciplinary course "ZukunftGestalten@HM—Future City" at MUAS. We particularly refer to sustainability in the strategy of MUAS, the organizational setting of sustainability and the measures to make it happen in MUAS.

- Secondly, based on the general outline above, we then describe "ZukunftGestalten@HM—Future City" in a more detailed fashion along its underlying pedagogic objectives in education science. Here we shed light to the key competencies issued by the OECD and the concept of "Gestaltungskompetenz" (German: capacity to develop and shape the future) as it represents the most popular concept for ESD in Germany. We make clear how the didactical concept of the course addresses these competencies through both, content and methodology. Corresponding to descriptions and underlying conceptual basics above, we then present the course as a part of the strategic urban development project "Perspective Munich" of the City of Munich.
- Based on the experiences we gained so far at MUAS with that ambitious and new course format, we finally derive some conclusions and provide early recommendations on how to provide transdisciplinary approaches for ESD, ready to be applied in other universities.

2 Sustainability at the Munich University of Applied Sciences

2.1 Sustainability in the Strategy of Munich University of Applied Sciences

MUAS with around 18,000 students ranks among the largest Universities of Applied Sciences in Germany. It is located in a top-rated European economic metropolis. Its size and location provide options, but require responsibility within an array of different economic and social contexts. MUAS faces this multi-level social challenge among others by creating diversity across its various disciplines. MUAS offers degree courses and active academic collaboration in the MINT subjects mathematics, computer science, natural sciences and engineering, business administration, social sciences and public health as well as in architecture and design.

MUAS is committed to cultivating and developing the sciences through research, teaching and higher education, study and professional development in a free, democratic and fair state governed by the rule of law. Based on its political mandate, the MUAS executive board has developed areas where suitable access routes and study opportunities can be provided for diverse groups of students. Students are prepared both, professionally and personally for career paths with academic requirements in the areas "bachelor's degrees", "master's and doctoral training", "occupational study" and "applied research".

The MUAS management is currently focusing the overall strategy by developing a convincing and sound profile. University graduates are expected to distinguish themselves along three characteristic features, i.e. "entrepreneurial", "sustainable", and "cross-cultural". A set of measures have been implemented in all these areas in order to bring about the targeted competences. Within teaching and higher

education, profile-building competences are often combined with specialized subjects. Further, interdisciplinary forms of teaching and higher education—independent of any specific course of study—are also offered. These impart interdisciplinary elements of profile competences.

2.2 Sustainability as a Distinguishing Characteristic

MUAS's understanding of sustainability is based on the integrative triangle of sustainability (Deutscher Bundestag 1998; Jörissen et al. 1999). MUAS graduates are expected to be able, methodologically and technically, to respond to the grand challenges and key societal issues of social, economic and ecological/technological sustainability in future decades. Important aspects of a MUAS graduate's skills profile include therefore:

- ability to recognize the complexity of material and social living conditions and their links to global contexts and dependencies,
- ability to analyze and evaluate environmental, economic and socio-cultural issues,
- awareness of the limited nature of resources and the consideration of these limits in planning projects and implementing solutions,
- responsibility in one's decision-making, planning and actions,
- linking one's own actions with the ethics and basic moral principles like intra-/intergenerational justice, global justice, resource conservation, and taking a holistic approach, and
- forward-looking and future-orientated way of thinking, application of foresight methods and implementation of planning tools according to the precautionary principle.

3 Institutional Embedding of Sustainability

3.1 Challenge

The most relevant mission for MUAS is educating students. Hence when developing its sustainability profile, the focus is on teaching and higher education. Profile-building, however, does not just take place in teaching and higher education, but in all other areas of the university where students participate, directly or indirectly. For this reason, and in order to meet the overall responsibility of a higher education institution, MUAS's objectives in terms of sustainability are not purely expressed as goals along competences.

Sustainability at MUAS is directed both, outwardly and inwardly (Isenmann 2013). Outwardly, innovative contributions towards a sustainable society are made through teaching and higher education, research and professional development.

Inwardly, sustainability in using resources, environmental management and organizational development is a fundamental principle for MUAS.

In order to achieve these objectives, the traditional structures of a university, where faculties act as rather independent organizational units categorized according to a rather monodisciplinary structure, are appropriate only to a certain extent. Profile-building in sustainability cannot be limited to single monodisciplinary structures. Hence MUAS is going to gradually establishing structural elements developing links and bridging the gaps between faculties, up from an intra-faculty level to an inter-faculty level, finally also reaching across the entire university (Isenmann and Zinn 2015a).

MUAS is currently undergoing a development path in terms of structural change. Among other forces, the Bologna Reform with its emphasis on professional qualifications and competencies and the associated modularization of study is still a major driver. In many courses and modules the focus on professional qualifications and competencies require contents are not exclusively subject-specific, but are composed of a general, core knowledge of a subject, a degree of specialization. Moreover, contents may lead towards a specific profession. In order to promote employability there are also so called key skills that transcend subject matter, like the ability to work in a team.

The impact of this development on the creation of new interdisciplinary university structures is highlighted in the study "Jenseits der Fakultäten" ("Beyond the Faculties"), issued by the Stifterverband für die Deutsche Wissenschaft ("Donors' Association for German Science") (Reichert et al. 2012). The study attempts to systematically record, categorize, and analyze the new ways in which science is organized and, in doing so, sheds light onto a hitherto neglected area of the higher education policy debate on differentiation.

4 Measures to Embed Sustainability at MUAS

First, sustainability was incorporated as a crucial strategic issue both, in the University Development Plan (HEP 2010) and in the MUAS target agreements with the Bavarian State Ministry (ZV 2014). A key objective is to incorporate sustainability widely at MUAS across all areas and fields of action. This overall incorporation of sustainability as an integral part in a university field of action is exactly what the global action program calls "whole institutional approach" (UNESCO 2014). Various measures have been launched to approach this ambitious objective in a long term perspective.

MUAS is a founding member of BenE e.V., a worldwide network of 138 Regional Centres of Expertise (RCEs, www.rce-network.org) specialized for ESD, and a member of the nationwide working group "University for a Sustainable Development".

In research, a considerable number of externally funded projects are currently conducted in key areas of sustainable development, such as buildings efficiency/renewable energies (environmental and technological), demographic development/ageing society (social), alpine tourism/sustainability management (economic).

In order to overcome the technical and organizational hurdles of specialist faculty structures and in order to exploit the powerful knowledge and expertise between and across faculties, MUAS is currently pursuing a set of customized approaches:

- "ESD" coordination unit: A project team from the strategic advancement office coordinates and initiates university-wide the teaching and higher education activities for sustainability. Professors serving as ESD officers provide feedback from faculties.
- "Sustainable Future Management" professorship: A professorship especially dedicated to "Sustainable Future Management" was set into place in 2011. This temporary professorship is a part of the above mentioned BMBF-project "Future proof". The ambitious tasks include research and courses striving for sustainability, preferably in the faculty of business administration. Further, the professorship is in charge of the development of an overarching ESD framework for MUAS, the design of innovative ESD course formats at cross-faculty level and a professional network management focused on ESD.
- Faculty of general and interdisciplinary studies: A special feature of MUAS is the Faculty of general and interdisciplinary studies offering modules across disciplines, like "Fundamentals of Ethics", "Europe's Future—a green global economy" or "Business Ethics".
- "Strascheg Center for Entrepreneurship (SCE)": The SCE forms a non-faculty entity. It is an institute affiliated to MUAS. And the SCE supports the development of interdisciplinary skills e.g. with "Real Projects", a MUAS study program that imparts entrepreneurial ways of thinking and acting through practical interdisciplinary projects with company participation.
- Interdisciplinary Lecture Series: This lecture series has a certain focus in a hot issue in each semester. One of its foci is on "Social Innovations".
- Central Scientific Department: MUAS runs a scientific department in the "occupational study" area, where module studies, certificates and study programs in sustainability are also expected to be available.
- Science Support Centre (FORWIN): MUAS operates the FORWIN centre to support research and doctoral studies. At FORWIN, amongst other things, research proposals on sustainability are reviewed and selectively placed with professors.
- Transdisciplinary Teaching Projects: Transdisciplinary, problem-orientated teaching projects are supported in terms of organizational issues and the curriculum. It is a rather new instrument, particularly for promoting profile-building activities. A shared, weekly university-wide time-slot has been put into the timetable for all bachelor's degree courses. In this time-slot, students from different degree courses, supervised by a group of lecturers from various

disciplines, work on a common project. Curricular integration takes place in each case via a project module in the students' degree course. The "ZukunftGestalten@HM—Future City" teaching project here showcases this course format.

5 Course Format "ZukunftGestalten@HM—Future City"

"Sustainable development and social cohesion depend critically on the competencies of all of our population—with competencies understood to cover knowledge, skills, attitudes and values (OECD Education Ministers)" (OECD 2005, p. 4). As a result of the Definition and Selection of Competencies (DeSeCo) Project the OECD issued three major competency categories: (1) using tools interactively, (2) interacting in heterogeneous groups, (3) acting autonomously.

- The first category "using tools interactively" covers the following competencies in detail: (A) Use language, symbols and texts interactively, (B) Use knowledge and information interactively, (C) Use technology interactively. For the OECD these competencies are legitimated by "the need to keep up to date with technologies", as well as the need to "adapt tools to one's own purposes" and to "conduct active dialogue with the world" (OECD 2005, p. 10).
- The second category "interaction in heterogeneous groups" includes the competencies: (A) Relate well to others, (B) Co-operate, work in teams, (C) Manage and resolve conflicts. These competencies are driven by "the need to deal with diversity in pluralistic societies" (OECD 2005, p. 12), the importance of empathy and social capital.
- Finally the third category "acting autonomously" summarizes the competencies (A) Act within the big picture, (B) Form and conduct life plans and personal projects, (C) Defend and assert rights, interests, limits and needs and refers to the need to "realise one's identity and set goals, in a complex world" and to "exercise rights and take responsibility" as well as to "understand one's environment and its functioning".

The debate about ESD in Germany is rather influenced by the concept of the "Gestaltungskompetenz" (German: capacity to develop and shape the future), introduced by de Haan (2010). "Gestaltungskompetenz means the specific capacity to act and solve problems preferably in self-organized manner. Those who possess this competence can help, through active participation, to modify and shape future society, and to guide its social, economic, technological and ecological changes along the lines for sustainable development" (de Haan 2010, 320).

de Haan (2010, p. 320) structures Gestaltungskompetenz into twelve sub-competencies, "namely the ability to:

1. gather knowledge in a spirit of openness to the world, integrating new perspectives;

2. think and act in a forward-looking manner;
3. acquire knowledge and acting in an interdisciplinary manner;
4. deal with incomplete and overly complex information;
5. co-operate in decision-making processes;
6. cope with individual dilemmatic situation of decision-making;
7. participate in collective decision-making processes;
8. motivate oneself as well as others to become active;
9. reflect upon one's own principles and those of others;
10. refer to the idea of equity in decision-making and planning actions;
11. plan and act autonomously; and
12. show empathy for and solidarity with the disadvantaged"

The OECD key competencies and the Gestaltungskompetenz with its twelve sub-competencies show correlation and development of competencies (Table 1):

These competencies are the objectives of "ZukunftGestalten@HM—Future City" and they provide the conceptual background for the didactical principles and underlying methodology.

As an "urban real lab", "ZukunftGestalten@HM—Future City" is a hands-on seminar and real-life project. It emphasizes the recognition that the MUAS is explicitly taking responsibility to contribute to a more sustainable development to its local environment, i.e. the city of Munich. For this reason, the course is offered in cooperation with the "Referat für Stadtplanung und Bauordnung" (German: department for urban planning and building regulations) of the city of Munich. With the work assignment to give impulses for a specific concept of district development called "Handlungsraumansatz" we tried to make sure that our students "act within the wider context" (P1.1) and "think and act in a forward-looking manner" (T2). As there is a great deal of "incomplete and overlying information" (T4) in the context of city planning, the students were forced to make decisions under uncertain conditions (described as "Contingency" by Parsons and Luhmann) (T4) and often they had to cope with dilemmas in their decision-making process (G1–G3). This approach also provided quite good insights into the "rights, interests, boundaries and requirements" (P1.3) of social change and development.

The students participating in the project are from eight different faculties, like architecture; mechanical, automotive and aeronautical engineering; electrical engineering and information technology; building services engineering; engineering and management; business administration; applied social sciences; general and interdisciplinary studies and tourism. All these students were arranged in cross-faculty teams of five participants. Each of these teams was coached by two lecturers, from different faculties. The coaches were professors and senior lecturers from eight different faculties. Their role as coaches is not to "teach", but to assist and support the teams, like a midwife. According to the classical Greek philosopher Socrates this certain role is described as "maeutics" or "maeutic method". As far as possible, the teams have to plan and act autonomously (E3). In this way, we made sure that the students do not just engage in interdisciplinary interaction within the group, but also with their coaches (T1). The interdisciplinary configuration of the

Table 1 Untitled (de Haan 2010, 321)

Classical competence terms	Competence categories in line with OECD (2005)	Sub-competencies of Gestaltungskompetenz
Subject and methodological competence [M]	[M1] Interactive use of media and methods	T1 Gather knowledge in a spirit of openness to the world, integrating new perspectives
	[M1.1] Ability to use language symbols and text interactively	T2 Think and act in a forward-looking manner
	[M1.2] Ability to use knowledge and information interactively	T3 Acquire knowledge and act in an interdisciplinary manner
	[M1.3] Ability to use technologies interactively	T4 Deal with incomplete and overly complex information
Social competence [S]	[S1] Interacting in socially heterogeneous groups	G1 Co-operate in decision-making process
	[S1.1] Ability to maintain good and durable relationships with others	G2 Cope with individual dilemmatic situation of decision-making
	[S1.2] Ability to cooperate	G3 Participate in collective decision-making process
	[S.1.3] Ability to overcome and resolve problems	G4 motivate oneself as well as others to become active
Personal competence [P]	[P1] Acting autonomously	E1 Reflect upon one's own principles and those of others
	[P1.1] Ability to act within the wider context	E2 Refer to the idea of equity in decision-making and action planning
	[P1.2] Ability to form and implement a life plan and personal projects	E3 Plan and act autonomously
	[P1.3] Awareness of rights, interests, boundaries and requirements	E4 Show empathy for and solidarity with the disadvantaged

teams across faculties and the "inter-disciplinary" assistance offered by two coaches from different faculties are key to the didactical approach. Such an approach provides the opportunity to experience subject-specific principles by means of perception and action as well as to reflect one's own principles (E1).

Because of the huge amount of organizational work involved, this didactical concept could hardly have been realized without further expertise and supportive infrastructure. Nowadays, with advanced interactive ICT (information and communication technologies) and sophisticated software tools, like e-learning platforms, online meeting-rooms, and e-portfolio-systems, the opportunities for new didactics may sound to be without limits. In "ZukunftGestalten@HM—Future City", the MUAS' E-Learning-Center provided great support: with personal resources, outstanding expertise, and leading-edge ICT. "ZukunftGestalten@HM—Future City" was equipped with an elaborated tool set of interactive technologies to facilitate

project management and collaborative team work among all participants: An online platform in moodle (https://moodle.org) was implemented as a central web based working platform. Tools like Adobe Connect allowed virtual teamwork and web based meetings á la 24/7, independent from place and time (http://www.adobe.com/products/adobeconnect.html). Mahara (https://mahara.org/), a fully featured web application to build e-portfolios, was used to present the working results of the teams, online and hypermedia-featured. The structured tool set allowed an efficient overall project management, individualized student support, specific and general information as well as simultaneous communication where needed, a qualitative assessment of the work's results and no less important: a feasible presentation style of the results to the partners involved in the Department for City Planning and Building Regulations as well as to the further interested parties in the city of Munich and other stakeholders in society and the scientific community.

6 Urban Real Lab Case: "Zwischen Milbertshofen und Freimann. Wohnen, Arbeiten, Bildung und Sport Im Münchner Norden"

As a tangible, local, and real life example we have focused on an ongoing strategic urban development project of the city of Munich. The Department of Urban Planning and Building Regulation is responsible for the strategic concept of urban development "Perspective Munich". "Perspective Munich" serves as an orientation framework for the future development in Munich. Apart from the overall urban and thematic point of view, a successful urban development needs both, a detailed urban and an integrative perspective. Therefore, the department adopts a new approach to develop priority areas of urban development, so-called "Handlungsräume". Due to their particular dynamics, "Handlungsäume" usually offer chances and enable a variety of new options, but they are also incorporated with uncertainties and risks. Thus, they need special attention and particular care to a high degree. For these areas integrated concepts are to be established, in which the development goals and measures for the next ten years will be defined. Individual plans, measures and projects are given a framework, whereby a common understanding of planning should be supported for different actors.

The transdisciplinary and integrated approach is a characteristic feature of the new instrument. It includes visioning projects developing different scenarios (John et al. 2015), an analysis of challenges and potentials, assessment of opportunities and risks, a definition of strategic objectives, and also recommendations for realization and implementations. Such a challenging effort calls for a cooperative culture of administration and planning. The balancing of different interests as well as the realization of objectives in different urban areas should be facilitated. To ensure acceptability of any urban projects and measures, public participation need to be taken into account. In a sense, this corresponds to an inclusive 'bottom-up' community foresight process for urban sustainability research as described by

Eames and Egmose (2011). One of the ten priority areas of urban development has been chosen as an example for "ZukunftGestalten@HM": "Between Milbertshofen and Freimann. Housing, Labour, Education and Sport in the North of Munich" (Zwischen Milbertshofen und Freimann. Wohnen, Arbeiten, Bildung und Sport im Münchner Norden, Landeshauptstadt München 2013). This area shows a special dynamic particular in growth. Several new urban areas arise by converting former barracks and commercial areas. The expansion of the BMW Group's Research and Innovations Center (FIZ) creates several thousand new jobs, and it strengthens the high-tech metropolis of Munich. Among others, this dynamic requires a sustainable traffic development beyond the city's boundaries and a needs-driven development of social and technical infrastructure. Further topics are education, integration and sports facilities, protection and development of commercial areas as well as environmental planning and green fields in collaboration with some other neighbouring municipalities.

7 Conclusions

The main goal of "ZukunftGestalten@HM—Fututre City" was to create a course on ESD with a transdisciplinary approach while addressing the development of competencies in sustainability. In form and content the course had to be linkable to different curricula and interests of students from rather different faculties and academic cultures, like architecture, engineering sciences, tourism, and social work. Hence it is clear that a course like this is a first example and ongoing development, with an amount of challenges.

One of the biggest challenges was—and still is—an organizational one: to set up a common time-slot available for all students in faculties who may join and participate. Only a free time-slot scheduled in any faculty gives the opportunity for collaboration across faculties. The fact, that MUAS put a shared, weekly, university-wide time-slot into the timetable for all bachelor degree courses is a great improvement for ESD at MUAS. But as most time-tables are planned before, the new time-slot is not yet scheduled in most of the degree student programs. A full integration of the time-slot will need some time as well as the recognition of decision makers that a transdisciplinary approach is of high value, e.g. for professors, students, and partners outside universities and academia involved.

Another organizational challenge for a course on ESD with a transdisciplinary approach is the fact that any planning and decision making usually exceeds a faculty's boundaries. It needs to be organized by a university-wide coordination unit. For example, an ESD coordination unit—if even established—needs at least some personal, financial and technical resources. No less important, it has to be integrated into the university's organization and management. For collaboration like this, representatives for ESD have to be found in every faculty, be it professors, senior lecturers or other promoters. Intrinsic motivated professors and senior lecturers are a prerequisite for a course like "ZukunftGestalten@HM".

A further task for a course like "ZukunftGestalten@HM" is to find a smart topic, attractive and sound for all participants. Especially with a transdisciplinary approach it's challenging to set up a topic that meets at the same time the interest of students with rather technical foci like in "hard science", such as natural and engineering sciences, and those with social or cultural foci like in "soft science", such as social sciences. Furthermore, the assignments need to meet the different requirements of heterogeneous curricula in faculties, the interests of partners involved, and a proper level of students' skills. In addition, the crediting of the course with the same amount of ECTS in all participating faculties is just another task that has to be solved.

In total, "ZukunftGestalten@HM" is much more than just an orthodox project-based course. It's the interim outcome of a long-term development path, while trying to incorporate sustainability into university's higher education—and hopefully in the long run—into MUAS as a whole, including various capacity building and organizational learning processes (Shiel et al. 2015). The experiences made and the insights gained from "ZukunftGestalten@HM—Future City" may initiate further discussions about the future of higher education as well as the organization and structure of student programs.

The overall experiences of all participants made—professors, senior lectures, students, facilitators, experts of the City of Munich—as well as their insights and early evaluation results clearly demonstrate: "ZukunftGestalten@HM—Future City" provides an excellent example of a transdisciplinary approach in ESD, combing higher education for sustainability on the one hand and designing the future—here of the city of Munich—in an urban real lab case on the other.

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Engaging Stakeholders for Sustainable Development

Walter Leal Filho and Luciana Brandli

Abstract

The engagement of various stakeholders is essential in order to cater for the implementation of sustainable development. This paper discusses the extent to which such an engagement takes places, draws some parallel between universities and companies, and outlines some of the limitations which prevent it from being more widely practiced.

Keywords

Sustainable development · Stakeholders · Integration · Committment

1 Introduction

The complexity, deepness and versatility of the topic 'Sustainable Development' entails the involvement of a large variety of interest groups. The importance of their participation in environmental decisions was raised in the 1992 at the UN Conference on Environment and Development, in Rio, and later stated officially, both in Principle 10 of the Rio Declaration and Agenda 21 (Chartered Institution of Water and Environmental Management 2006).

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Today, the actuality of sustainable development issues asks business one the on hand, but higher education institutions on the other, to take co-responsibility on the topic (Cuginotti 2009). Therefore, organisations are required or even enforced to examine their business practices and determine their long-term social and environmental impacts, as well to innovate the business models, products and services in an attempt to find sustainable solutions for the problems they may cause (Rhodes et al. 2014).

One of the approaches applied in related decision-making processes is the collaboration with **stakeholders**, i.e. those who have an interest in a particular decision or course of action, either as individuals or as representatives of a group (Hemmati 2002). This includes any group or anyone who can be affected or is affected by the achievement of the organization's objectives (Freeman 2010). Among the groups of stakeholders, one may mention universities on the one hand, and financial institutions (e.g. banks, shareholders) government (e.g. regulators, local government), business (e.g. employees, customers) and/or other groups (e.g. communities, NGOs) (SustainAbility 2007) on the other.

Complex operating environments and a variety of sustainability issues require higher education institutions and companies as well, to consider the relationship with their stakeholders at the strategic level (Cuginotti 2009), since they have the ability to influence the success or failure of their operations (SustainAbility 2007). Knowledge sourced from such collaboration affects the sustainable innovation orientation that may contribute to sustainable development (Ayuso et al. 2011; Rhodes et al. 2014). Furthermore, stakeholder involvement in environmental decision-making improves the quality of decisions (Beierle 2002). Therefore, both universities and companies see it as necessary to engage their respective stakeholders, in their activities.

The **engagement process** is the process of exchanging information, listening to and learning from stakeholders (SustainAbility 2007). The overall purpose of stakeholder engagement is to drive the strategic direction and operational excellence for organisations, and to contribute to the kind of sustainable development from which organisations, their stakeholders and wider society can benefit from (Unerman et al. 2010).

Among the benefits of stakeholder engagement, most experts name the following:

- it leads to more effective work and production of better results by decision-makers;
- it can improve the likelihood of equity in decision-making and provide solutions for conflict situations;
- it allows the ideas to be tried, tested and refined before adoption (Conde et al. 2004).

By engaging stakeholders on sustainability issues for instance, universities may get an opportunity to better understand the market condition, promote their reputation, build trust and long-term collaborative relationships, as well as better understand and mitigate the threats and uncertainties related to the business (Bal

et al. 2013). In addition, stakeholder engagement can be seen as a social learning process, where diverse stakeholders share a common forum, learn about each other's values, reflect upon their own values and create a shared vision and objectives (Mathura et al. 2008).

Successful and effective stakeholder engagement requires among others listening, openness, dialogue, resources, integration and collaboration, leadership commitment, understanding of needs, systemic thinking, capability to deal with environment and market volatility and ambiguity (Rhodes et al. 2014).

However, despite the aforementioned benefits, the engagement of stakeholder has limitations and failings as well.

2 Problems in Engaging Stakeholders for Sustainable Development

The problems and challenges of achieving successful and effective stakeholder engagement are caused by many factors. The risk of failing to engage stakeholders in a timely and strategic manner is relatively high (SustainAbility 2007). Among the problems associated with the successful implementation of the approach, mention can be made to:

(a) ***Lack of an unified scheme***

Despite a great number of existing methods of stakeholder engagement, there is no single formula for success. The methods vary from quite passive interactions, where the stakeholders provide information, to "self-mobilisation", where the stakeholders themselves initiate and design the process (Conde et al. 2004).

(b) ***Conflict of interests***

An enormous variety of interest groups undoubtedly leads to the collision of interests resulted in different priorities and conflicts that might dramatically increase the complexity of a situation (Karlsen et al. 2008). To encourage positive stakeholders behaviour, both universities and companies should provide them with a better way to advance their interests, i.e. to consider their opinion in defining solutions (National Round Table on the Environment and the Economy & Public Policy Forum 2010). In addition, the engagement process should be designed in the way to encourage stakeholders to stop competing and start collaborating. However, it is important to note that such processes not always succeed because of possible irreconcilable differences, situation when consensus cannot be achieved (National Round Table on the Environment and the Economy & Public Policy Forum 2010).

For example, the municipal experience of community engagement in planning and urban development decisions in the City of Guelph (Ontario, Canada) has demonstrated that even well-managed and extensive community engagement efforts do not necessarily guarantee easy implementation. While most of participants accepted proposed decisions on this example, there are those who do not, despite

being consulted (National Round Table on the Environment and the Economy & Public Policy Forum 2010).

Some of the experts see multi-stakeholder engagement at the global level as problematic since voluntary public-private governance arrangement might privilege more powerful actors e.g. "big business" and consolidate the privatization of governance. Some argue that partnerships lack accountability and democratic legitimacy (Biermann et al. 2007).

(c) ***Lack of capacities/Insufficient capabilities***

Shifting from traditional forms of stakeholder management to proactive forms of stakeholder engagement requires a new capacity of resources (Rhodes et al. 2014). Organisations are required to communicate, negotiate, contract, and manage relationships with stakeholders and motivate them to behave in ways that are beneficial to all parties (Harrison and John 1996).

Specific skills, training, knowledge, and particular behaviour of people in all parts of an organisation are required to get best results from stakeholder engagement initiatives (Rhodes et al. 2014; Chartered Institution of Water and Environmental Management 2006).

Many companies and many institutions of higher education, tend to lack strategy of stakeholder engagement (Kuenkel 2013), since they do not always consider these processes as part of daily operations in their core business. On the other hand, the credibility of the participation of stakeholders might also be questioned on the basis of insufficient expertise of many of them to be meaningfully engaged in, for example, in highly technical debates (Reed 2008).

(d) ***Too many different stakeholders***

Another problem of stakeholder engagement faced by businesses and universities as well, is a variety and quantity of interest groups. It becomes very challenging to identify and prioritize all possible stakeholders (e.g. from most to least important/crucial). Many companies suffer from a lack of focus when engaging stakeholders, failing to define their goals, reasons and purposes (Kuenkel 2013).

For example, to achieve sustainability-related targets in construction projects, experts confront many diverse stakeholders, some of which are generally recognized as important, yet others, who not always perceived as such, but whose absence from the decision-making processes may result in a failure to address sustainability issues (Bal et al. 2013).

(e) ***Later stage of stakeholder engagement***

To achieve successful and effective stakeholder engagement, the interest groups/individuals should be engaged at the first stages of a project or decision-making process. Problems are far more likely to occur when people are engaged later in a process, when they start raising objections to what is being proposed or starting to be implemented (Chartered Institution of Water and Environmental Management 2006).

(f) ***Stakeholder fatigue and cynicism***

A growing number of issues/projects asking for stakeholders participation may lead to stakeholder fatigue, especially, when these processes not run well and stakeholders perceive that their involvement gains them little reward or capacity to influence decisions that affect them (Reed 2008). Moreover, the resulting cynicism can lead to declining levels of engagement and put the credibility of participation at risk (Reed 2008). One of the ways to prevent fatigue is to demonstrate stakeholders that their participation is worthwhile (Chartered Institution of Water and Environmental Management 2006).

(g) ***Risks for government***

Today a large number of issues related in one or another way to sustainable development, are considered to be sensitive, highly politicized and found under permanent public disclosure, with every move of government under intense scrutiny from stakeholders on all sides. Therefore, initiation of collaborative or consultative processes is sometimes criticised as shifting responsibility about one issue, even when the opposite is true. At the same time, there is always a risk that stakeholders are also not willing to take on responsibility (National Round Table on the Environment and the Economy & Public Policy Forum 2010).

(h) ***Barriers in a direct dialogue and engagement with some stakeholders***

Among the main stakeholders on the sustainable development debate are the future generations. Thus, organisations/companies do not have any real possibility to engage stakeholders from future generations in dialogues regarding activities/processes that currently taking place and have long-term impacts on nature and society, and by which these stakeholders might be affected in the future. It cannot be denied that there are groups of contemporary stakeholders e.g. NGOs or university students, that might position themselves as representatives of specific interests of future generations, but there is a high probability that future generations might judge their interest differently (Unerman and O'Dwyer 2006). Similar issues arise regarding other groups of stakeholders, who are less able to articulate their own concerns and interests (for example, infants or the mentally impaired) (Unerman et al. 2010).

3 Conclusions

Despite the wide range of challenges and limitation associated with the stakeholder engagement approach, the well-managed process might decrease negative environmental impacts and increase the economic sustainability of an enterprise of higher education institution (Bal et al. 2013).

Stakeholders can be engaged in many different ways, which goes from information sharing to participation in decision-making, following one of five engagement levels: inform, consult, involve, collaborate and empower (Pellicano et al.

2014). In addition, stakeholders could be identified by one of the following dimensions:

- by responsibility: people to whom an organisation has, or might have, legal, financial and operational responsibilities;
- by influence: people who are, or might be, able to influence the ability of a company/organisation to meet its goals;
- by proximity: people that a company/organisation interacts with most, or has longstanding relationships;
- by dependency: people that are most dependent on a company/organisation (e.g. employees, customers);
- by representation: e.g. heads of a local community, trade union representatives, councillors, representatives of membership based organisations, and etc. (Krick et al. 2005).

To achieve successful stakeholder engagement, universities and companies could follow such steps as identifying all key stakeholders, relating the stakeholders to different sustainability-related targets, prioritizing the stakeholders, managing stakeholders, measuring their performance and putting targets into actions (Bal et al. 2013).

Moreover to avoid ambiguity in the engagement process it is suggested to clarify activities that lead to frustrated expectations and disappointed hopes. There are several areas that must be clear to all participants for well-worked collaboration:

- **clarity on goals, scope and context**: all participants should understand the broader context of sustainable development;
- **clarity on roles and responsibilities**: participants should understand each other's capacities to act their responsibilities;
- **clarity on timelines**: it should be clearly defined how long a process will take place to avoid participants seeking venues outside the collaborative process to meet their goals;
- **clarity on rules:** to avoid misunderstandings and disagreements, which undermine trust and prevent progress (National Round Table on the Environment and the Economy & Public Policy Forum 2010).

In addition, the process must be designed in a way to ensure that everyone will have a meaningful voice in designing a strategy, plan or policy. Thus each stakeholder will feel confident that his/her interests will be considered and addressed (National Round Table on the Environment and the Economy & Public Policy Forum 2010).

Nevertheless, despite a number limitations, claims and uncertainties regarding the stakeholder engagement approach, its successful implementation helps universities and companies to bring about systemic change towards sustainable development (Krick et al. 2005) together with significant environmental and business benefits, and creation of a model that other organisations could follow, or that could be followed by government (Glasbergen 2011). At the global level multi-stakeholder partnerships are considered as a solution to deadlocked intergovernmental negotiations,

ineffective treaties and many other real or perceived current problems (Biermann et al. 2007), therefore stakeholder engagement should be taken as a core element of any "sustainable development" plan (Bal et al. 2013).

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