World Sustainability Series

Walter Leal Filho
Constantina Skanavis
Arminda do Paço
Judy Rogers
Olga Kuznetsova
Paula Castro *Editors*

Handbook of Theory and Practice of Sustainable Development in Higher Education

Volume 2

Springer

World Sustainability Series

Series editor

Walter Leal Filho, Hamburg, Germany

More information about this series at http://www.springer.com/series/13384

Walter Leal Filho · Constantina Skanavis
Arminda do Paço · Judy Rogers
Olga Kuznetsova · Paula Castro
Editors

Handbook of Theory and Practice of Sustainable Development in Higher Education

Volume 2

Springer

Editors
Walter Leal Filho
FTZ-ALS
HAW Hamburg
Hamburg
Germany

Constantina Skanavis
Department of Environment
University of the Aegean
Mytilene
Greece

Arminda do Paço
Business and Economics, NECE
University of Beira Interior
Covilhã
Portugal

Judy Rogers
School of Architecture and Design
RMIT University
Melbourne
Australia

Olga Kuznetsova
Manchester Metropolitan University
Manchester
UK

Paula Castro
Department of Life Sciences, Centre for Functional Ecology
University of Coimbra
Coimbra
Portugal

ISSN 2199-7373 ISSN 2199-7381 (electronic)
World Sustainability Series
ISBN 978-3-319-47888-3 ISBN 978-3-319-47889-0 (eBook)
DOI 10.1007/978-3-319-47889-0

Library of Congress Control Number: 2016954518

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

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

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

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

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

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

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

This volume is structured around two parts.

Part I, under the heading "Sustainability Initiatives and Indicators," describes a variety of initiatives which illustrate a wide scope of sustainability initiatives and considers to some extent some of the indicators being used.

Part II, titled "Integrated Sustainability Practices," contains a set of papers which outline various means via which universities have implemented sustainable development practices, with a special emphasis on case studies and practical examples which illustrate how student participation may be increased, also describing experiences showing how sustainability elements may be included in the

curriculum on the one hand but also on research schemes on the other, based on some concrete examples from projects.

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

Enjoy your reading!

Hamburg, Germany — Walter Leal Filho
Mytilene, Greece — Constantina Skanavis
Covilhã, Portugal — Arminda do Paço
Melbourne, Australia — Judy Rogers
Manchester, UK — Olga Kuznetsova
Coimbra, Portugal — Paula Castro
Winter 2016/2017

Contents

Part II Integrated Sustainability Practices

Part I
Sustainability Initiatives and Indicators

Sustainable Cities, Sustainable Universities: Re-Engineering the Campus of Today for the World of Tomorrow

Ronnie D. Lipschutz, Dominique De Wit and Martin Lehmann

Abstract

On hundreds, if not thousands, of campuses across the world, courses, policies and infrastructure have been designed and revised in the pursuit of sustainability. A similar goal is pursued by as many cities. But, while there are many policies and many projects, how they fit together and contribute to the larger objective is not at all clear. In this paper, the shortcomings of most sustainability programs and projects in campuses and cities are addressed, and it points towards the need to develop a more-historical, holistic and dynamic "ecosystem" approach. This paper offers several models for working in this direction and a brief case study of "sustainable food" at UC Santa Cruz as a preliminary illustration.

Keywords

Sustainability · Campuses · Cities · Models · Ecosystems · Food

R.D. Lipschutz (✉)
Politics Department, 234 Crown College, University of California, 1156 High Street, Santa Cruz 95064, USA
e-mail: rlipsch@ucsc.edu

D. De Wit
Politics Department, 12 Merrill College, University of California, 1156 High Street, Santa Cruz 95064, USA
e-mail: dodewit@ucsc.edu

M. Lehmann
Department of Development and Planning, Aalborg University, 9000 Aalborg, Denmark
e-mail: Martinl@plan.aau.dk

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_1

1 Introduction

The vast majority of the world's university campuses that will be in existence at the end of the 21st century already exist today. Some have just opened; others are close to a thousand years old. University campuses can be conceptualized as "living labs" (Evans et al. 2015) or even as "living systems," near-biological entities with organically-connected elements (Castan Broto et al. 2012), rather than mere agglomerations of pieces and fragments. Moreover, university campuses resemble cities in microcosm, in design, landscape and infrastructural terms, and both are types of *spatial* institutions that operate according to similar bureaucratic and decision making principles. Inside, all sorts of processes take place to sustain functioning, although these are not "planned" in any real sense, and sometimes these processes do not work.

The extent to which campuses and cities are treated as integrated, even "ecological," systems in order to understand and analyze complex relationships, and the degree to which education is connected to the management and operation of the whole, is limited. Indeed, even a holistic, analytical and operational approach can fall victim to the managerial and bureaucratic fragmentation characteristic of large institutions. One office manages water, another one deals with energy issues, a third one with waste and a fourth with the building maintenance matters. Each "sector" has its own department and interests to defend. Communication, much less develop integrated programs, is rare, and when one practice contradicts another—or renders the second impossible—there is little effort made to find a resolution. What is to be done?

University campuses can be laboratories for experimentation with holistic approaches, in terms of (re)design, landscape transformation, public participation and governance, and can provide important lessons and experience in larger projects. Transforming university campuses into sustainable entities, rather than merely institutions with sustainability projects, offers programmatic templates and practices that can be applied to the far more complex and daunting project of urban sustainability. In such an effort, university students, staff and faculty play a critical role. Students are often strongly motivated and committed to sustainability, especially as it involves activism and experiential learning. Staff engages in everyday operational activities that must be transformed and linked to be sustainable. Faculty possesses the knowledge and authority necessary to see through a comprehensive sustainability strategy. This paper examines activities and examples of how a university campus offers a site for experimenting with technologies, practices and infrastructural reconfiguration, with implications for the much larger problem of urban sustainability. The goal of this paper is, therefore, to address this organization-institutional dilemma: how can integrated planning be reconciled with fragmented institutions?

This paper begins with a brief discussion of the literature on making universities sustainable, much of which focuses either on rating and rankings or incorporation of sustainability education and research into the curriculum. Comprehensive,

long-term strategies across curriculum, facilities and management are rare. The consequent question then is: what might be involved in modeling the sustainable campus? Critical elements encompass not only the physical and material complications that always make campus reconfiguration difficult—where to dig, what should go where, who will be disturbed, who will oppose, who will pay?—but also bureaucratic and regulatory requirements that must be met before a shovel ever hits the dirt. The paper then discusses sustainability in the food sector at UC Santa Cruz as an example of integrated planning and design. This case is not necessarily exceptional in the world of campus sustainability, but it provides historical and empirical data that illustrate the paper's arguments. Finally, the conclusion draws lessons from the project of making a university campus sustainable that could be applied to sustainable cities.

2 Conceptualizing the "Sustainable University" and Student Learning

As concepts, "sustainability" and "sustainable development" are now several decades old; the term can be found in books, articles and agendas dating from the 1970s (Lipschutz 1991, 2012). Even so, clear definitions are difficult to come by: sustainability remains an essentially-contested concept (Gallie 1955). Progress towards sustainability goals has been slow and even controversial, as many campuses and cities (C&C) have come to experience (Velazquez et al. 2006). Few cities and campuses have developed in a careful way; more often, change is the product of ad hoc decisions made at many different times, in many different places, without much if any consideration of the whole. Infrastructures are substantially fixed; practices and populations are not (Ramaswami et al. 2012). It is often easier and less costly to tear down the old (or let it decay) and build anew, especially if new projects and developments are designed and built with care and foresight—although from the perspective of embedded resources, such replacement may be a foolish thing to do. Notwithstanding haphazard design, there are substantial sunk and opportunity costs associated with the way things are. The way things have always been done frequently trumps the way they ought to be (and ought to have been) done.

Given the complex histories of such institutions what, exactly, is a "sustainable university campus?" According to Alshuwaikhat and Abubakar (2008: 1778),

> Universities [like 'small cities']… have several activities and complex operations with potentially significant environmental impacts that, until recently, have been largely overlooked in terms of social and environmental responsibility… There is a common understanding in the literature that a sustainable university campus implies a better balance between economic, social and environmental goals in policy formulation as well as a long-term perspective about the consequences of today's campus activities.

Velazquez et al. (2006: 812) write that a "sustainable university" is

> A higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfill its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles.

Sustainable campuses begin to sound very much like sustainable cities:

> Figuring out how to make urban settlements more sustainable requires knowledge of how a local economy works, of how transportation systems are connected to land use and urban density, to economic activities, to housing supply [and] to other public infrastructures and services… The way urban systems work or fail to work together is a large part of the sustainability of an urban settlement (Blanco and Mazmanian 2014).

While sustainable cities and campuses are indisputably distinct entities, transitions to sustainability and efforts to help citizens and students (and the larger community) transition to sustainable lifestyles, need not be disjointed attempts. A growing body of literature examines collaboration between campuses and cities. Trencher et al. (2014) show that cross-sector partnerships for urban sustainability are flourishing across the world, bridging the gap between a sustainable university and a sustainable city. Other scholars have noted that such collaborations consist of a "process of mutual learning, through which researchers, government authorities and citizens exploit social innovation at the local scale to spur wider societal transitions by sharing experiences across trans-border networks" (De Kraker et al. 2013; see also Valkering et al. 2013; cited in Trencher et al. 2014).

Sustainability education in the campus environment, both as classroom instruction and hands-on experience, is the subject of extensive study. Among the most promising approach is the "living lab" which features, according to Evans and his colleagues, three "core characteristics…: they comprise a geographically or institutionally bounded space, they conduct intentional experiments that make social and/or material alterations [to the space], and they incorporate an explicit element of iterative learning" (Evans et al. 2015). Moreover,

> Living labs have the potential to strategically frame coproduction processes in two ways. First, consulting users and stakeholders allows complementary sets of projects to be strategically planned that offer holistic solutions to sustainability challenges. Second, by emphasizing the iterative process of experimenting and learning from year to year they provide a more coherent basis for action over time. Both of these elements are valuable in a university setting, joining up the institutional response to sustainability challenges and engaging students in focused and applied projects that clearly contribute to a longer term, bigger picture of sustainability (Evans et al. 2015: 2).

For example, the "University Living Lab" initiative, launched at the University of Manchester in 2012, utilizes the campus as an "amenable real world location in which to conduct applied research," allowing researchers, students, external stakeholders and environmental consultants and university staff to co-produce knowledge about new sustainability technologies and services in "real world" settings (Evans et al. 2015: 2). However, a closer examination of the specific program, as described in Evans et al. and on the University Living Lab website (http://universitylivinglab.org/) suggests that, while there are "hundreds of

academic and professional support staff at the University who deal with sustainability… [and] over 100 organizations that relate to sustainability,"[1] the "lab" is more of a cobbling together of many independent and autonomous projects that a coherent program.

Manchester is hardly unique in this. No one seems really to understand how the various parts of sustainability fit together or how students might learn about and experience an integrated system of sustainability–and the same is generally true of cities. Students and faculty remain trapped in their disciplines; staff in their departments or offices; workers in their own sector. Even the highly-regarded Arizona State University School of Sustainability (https://schoolofsustainability.asu.edu/) maintains the "two cultures" separation of science and philosophy (Snow 1961), offering an undergraduate BA "best suited to students interested in social sciences, humanities, planning or related fields" and a BS "best suited to students inclined toward natural sciences, economics, engineering or related fields."[2] There are no "sustainable campuses" (or cities, for that matter); there are only campuses and cities that pursue sustainability in many forms and fashions.

Why? For the moment, many efforts to achieve sustainability on campuses and in cities are driven by concerns about climate change, prioritizing decarbonization strategies in the built environment rather than paying broader attention to the social systems and institutions driving carbon burning (Bulkeley and Castan Broto 2012; Trencher et al. 2014). Research by Trencher et al. (2014) indicates that the built environment, energy, heating or cooling, and governance and planning are the three most commonly targeted urban systems by university sustainability partnerships—usually as distinct sectors. The sectoral approach to sustainability may miss many of the policy and decision points and the social practices that might be more critical for effective strategies. The problem thus remains: how is sustainability to be *implemented*?

3 Modeling the Sustainable University for Learning and Research

To begin, differentiate a *commitment* to sustainability from *implementation* of sustainable systems and practices. Commitments are made by many universities and cities (McFarlane and Ogazon 2011). Implementation is much more difficult and is usually evident only as piecemeal projects (Koester et al. 2006). The need for holism is widely recognized even as there are few, if any, cases in which it is actually practiced. Most analyses, models and programs focus on material flows

[1]"People," at: http://universitylivinglab.org/people; "Groupings," at: http://universitylivinglab.org/organisations (Last Accessed January 20, 2016).

[2]"Choosing a Sustainability Undergraduate Degree," Arizona State University School of Sustainability, at: https://schoolofsustainability.asu.edu/degrees/undergraduate/ (Last Accessed January 20, 2016).

into and out of the physical institution–that which can be measured becomes the measure by which progress is assessed. Tracking how much water flows in, where it is used and how much flows out is relatively simple; what happens "inside the box" of systems, institutions and people is not.

> As Beringer and Adomßent (2008) observe, the focus [of greening the campus] tends to be on operational transformation (i.e. resource conservation and efficiency improvements) and curriculum initiatives…. A systematic linking of academic–research and teaching–with facilities management and operations remains the exception. Furthermore, approaches which recognize the systemic nature of organizational change and which leverage campus sustainability via institutional drivers are as yet sporadic, and uncommon.

And, they (Beringer and Adomßent 2008) continue,

> As in any system, the system is bigger than its component parts; synergies – for instance between administration and research; research and teaching; research, teaching, and community outreach; and so forth – arise which present unique leverage points for sustainability in higher education.

As important as flows and stocks are, *why* stuff is flowing into the institutions and how, within those institutions, decisions are made about what should flow in and out is at the core of the issue. This means *people*. And people do not consume resources directly; they do so with different intentions, goals, meanings and outcomes in mind. Materials are utilized in the course of pursuing not only subsistence goals but also social, cultural and normative ends. Motivations for consumption and associated patterns and practices by individuals, groups and structures, and the rules, regulations, norms, planning and management that steer stuff to specific places and services and direct the waste out, are all important in analyzing the institution and its people and designing and implementing sustainability. Yet, they are most often ignored.

One approach to holistic incorporation of human and institutional factors in sustainability design and implementation is through a "human ecosystem" analysis (Fig. 1; Machlis et al. 1997; Force and Machlis 1997). Machlis et al. (1997) propose that

> The social order (individually, collectively, and in relationship to social institutions and social cycles) provides high predictability in much of human behavior. Taken together, social institutions, social cycles, and the social order constitute the social system. Combined with the flow of critical resources, this creates the human ecosystem. Each of these elements substantially influences the others. For example, changes in the flow of energy (such as an embargo and resultant rationing) may alter hierarchies of power (those with fuel get more) and norms for behavior (such as informal sanctions against wasting fuel).

Force and Machlis (1997. italics in original) further propose that the "social system" is composed of three parts:

> The first is a set of *social institutions*; defined as collective solutions to universal social challenges or needs….The second subsystem is a series of *social cycles*.... The third subsystem is the *social order*, which is a set of cultural patterns for organizing interaction among people and groups.

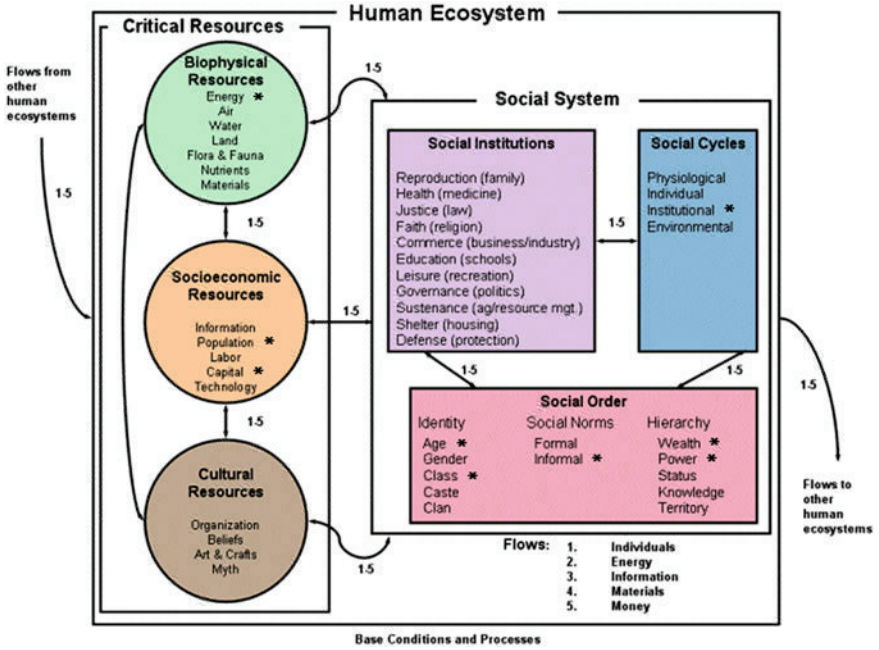


Fig. 1 The human ecosystems approach. [*Source* Frederick Area Watersheds Association, "The Human Ecosystems Approach," at: http://nbwatersheds.ca/fawa/the-human-ecosystem-framework (Last Accessed January 21, 2016), adapted from Machlis et al. (1997: 352). Reprinted by permission]

"Critical resources" constitute foundational flows into the human ecosystem, but it is social resources essential to the functioning and reproduction of the institution and the decisions, policies and actions that make the whole thing work. This framework is commonly used to examine human impacts on "natural" ecosystems, but there is no reason this framework cannot be applied as "institutional ecosystem" analysis by incorporating social factors and forces.

How can this be applied to the sustainable campus (and city)? Careful and detailed modeling of a campus's (sub)systems, institutional operation and social norms and practices can facilitate planning for sustainability, especially insofar as it identifies critical decision making and action sites and individuals that might not otherwise be recognized. Models are not the real world, of course, but they can be very helpful in terms of identifying feedbacks, synergies and unexpected outcomes, in understanding how subsystems and the overall campus operates and in posing and answering questions not only about what opportunities may exist for intervening in and modifying policies and actions relevant to campus sustainability. Given the sophistication of such models, it is possible to incorporate human and institutional behaviors that vary input behaviors to see results from contrasting decisions, policies and actions.

Thus, a *sustainable* campus approach, first, analyzes the functioning of its various services and the activities of its people as interconnected elements of a complex system of education *and* operation and, second, intervenes at those points and offices which result in the greatest gains relative to some baseline. This approach maps out the complex relationships and how they affect each other, and plans and acts with full cognizance of both those relationships and their effects, now and in the future. In this mapping process, the history of the institution is critically important, because current configurations and practices are products of the past and continue to shape the present and future in both material and social terms.

4 Completing the Sustainability Puzzle

As noted earlier, there is no shortage of sustainable education or sustainable management being practiced on university campuses (and in cities). What is absent from the literature (and, it would seem, from actual practice and policy) is the integrated approach to creating a sustainable campus described above. Both UC Santa Cruz (UCSC Sustainability Office nd) and Aalborg University[3] (Christensen et al. 2009) are making slow progress toward this analytical and applied goal, but they remain far from any optimum. If practicing integrated sustainability on campus is the puzzle, not all of the pieces are, as yet, on the table. Identifying which pieces are there and which are missing, to extend the metaphor to its breaking point, may make it possible to determine how to complete the puzzle.

Offered here is a modification of the Human Ecosystem approach that centers social and institutional factors as a means of completing the sustainability puzzle. What emerges from this exercise is a very rough model in which institutional procedures in campus sustainability are central: as previously observed, material facilities may be fixed once concrete is poured, but little else remains constant. Figure 2, roughly sketches out a "campus ecosystem," with three primary elements: (1) the "product chain," that is, the movement of a resource, good or service into, through and out of conceptual campus boundaries; (2) the material infrastructure that facilitates this movement, such as the buildings, tables, chairs, pipes, HVAC that "process" the good or service on its trip through the campus; and (3) the institutional arena, where policies and decisions are made regarding that movement, tastes and cultural preferences are expressed, markets are made and laws and regulations are enforced. Note that all three of these elements are significant "social" (rather than biological or geophysical) in that they focus on roles, rules, behaviors and practices.

Food provision on campus offers an illustration of this institutional "ecosystem." Virtually all universities provide a range of dining and food access services. Most, if not all, of the food that enters a campus comes from external sources (a few campuses grow some of their own food). In turn, most of the waste products—

[3]There does not appear to be any central sustainability website at Aalborg University.

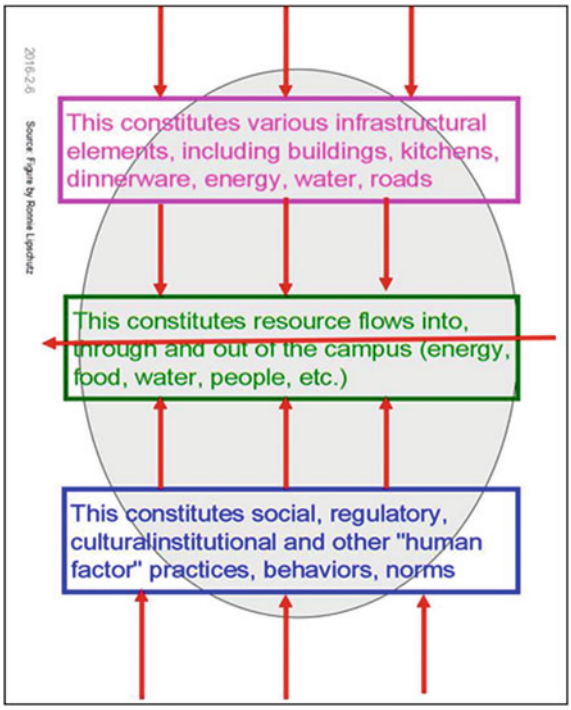


Fig. 2 Model of a campus ecosystem

paper, plastics, compostable, wastewater and sewage—are shipped off campus. Within the campus, there are food preferences, food planning and food preparation —and, of course, dining. In addition to food, other material inputs into the food system include dining halls, energy, water, dining utensils, refrigerators, freezers, stoves, ovens, tables, chairs, waste transport and disposal space, among many other parts. The required quantity of material things is a function of numbers of diners and their individual and aggregated food preferences and eating habits. Someone must devise meal plans and menus, matching purchases to demand, ensure workers are available to cook, distribute and clean up, maintain facilities and health standards and remove waste (and sewage). Students can learn, at home, from peers, in class and while eating, about what tastes good and what does not, how to choose more carefully and waste less, and what they might do to reduce food waste. Someone must mobilize the means of bringing in food and carrying wastes out; water must be provided in the required quantities and at mandated temperatures; the dining space and storage facilities must be heated and cooled. This does not exhaust the elements of the campus food ecosystem (Fig. 3).

Who are these "someone?" Students play a central role in shaping the food ecosystem through their upbringings, choices and preferences; they can also be an important constituency in forcing an institution to change its practices, in monitoring the efficacy of new practices, in conducting research. University officials in charge of dining and housing make decisions about what is to be offered, when

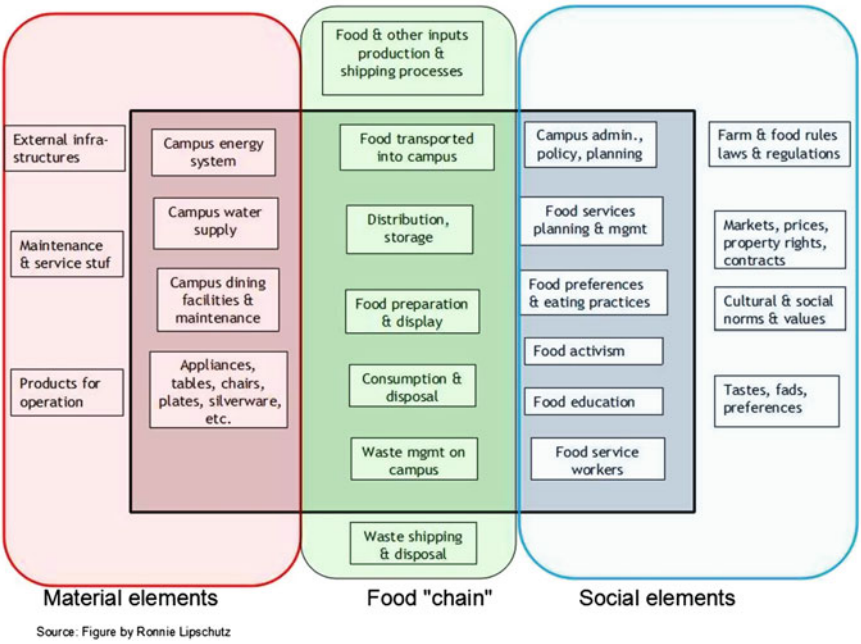


Fig. 3 A campus food ecosystem

meals will be available, from whom to purchase goods, and with whom to contract for operating the dining halls. Dining hall operators are important in terms of the foods and services they offer, the mix of both, and the quantities made available; garbage truck drivers are critical to make certain the waste does not pile up. And, as the saying goes, "many others."

The half-century history of the food ecosystem at UC Santa Cruz offers an illuminating example of how sustainability becomes integrated into the campus food system. This has not been a planned or designed trajectory even though it has resulted in an approximation of what might result from strategic planning. This history is too long to repeat here (UCSC Regional Oral History Collection 2003, 2008, 2010a, b; Center for Agroecology and Sustainable Food Systems nd; UCSC Regional History Project nd), but the interaction of student activism, faculty research, administrative policymaking and managerial action—the social—have played central roles. The dynamic looks something like this:

1. Movements of the 1960s foster activism around food origin and quality which becomes the basis for student activism;
2. Expert faculty member is recruited to develop and manage a Student Garden Project;
3. Administration approves hire and garden site, and subsequently approves project expansion; and

4. Additional faculty conduct research on food production and food systems, which
5. Stimulates further student activism with campus support for food-related research.

And so on. Figure 4 crudely illustrates this dynamic in a roughly chronological fashion. Absent one of the four "forces," the current degree of food sustainability would not have been achieved.

A similar historical, analytical and subsequent planning exercise could be undertaken for other components of a sustainable campus or city and, if possible, integrated into a single project. What elements must be mobilized, created or fostered in order to achieve objectives? Do these already exist? Where are the critical decision-making and action points and sites that might not otherwise be visible to causal analysis, observation and even influence? This approach offers ample opportunity for students across disciplines to identify the components of a campus (or city) resource ecosystem, to gather data from various sources and interviews, to ask people in key locations what they do and how they do it, to work with policymakers and managers and staff of the ecosystem "components," to develop and implement plans for increasing sustainability, and to coordinate among similar team engaged in similar projects elsewhere on campus or in the city.

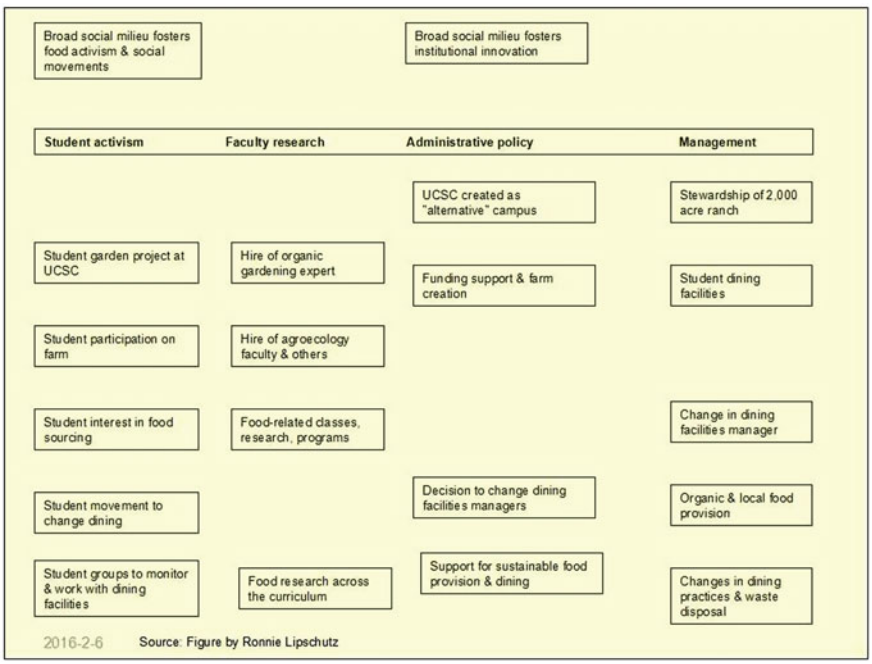


Fig. 4 The Sustainable food dynamic at UCSC

5 Sustainable Campuses, Sustainable Cities

The world and its social system, as well as its universities and cities, are far from achieving sustainability. What can be done to further this goal? This paper has argued that cities and campuses share many structural, infrastructural and institutional features, and that that which can be applied to one may also be applied to the other. But this paper has also argued that most efforts to become more sustainable are piecemeal ones focused on specific resource flows—food, energy, water, roads—without incorporation of the larger contexts and social activities that make these resources available. If analyses and actions begin with knowledge of those contexts and activities, and specify the role specific resources play in them, more significant, positive changes may be achieved than when goods are merely sourced more sustainably.

University campuses have been in the forefront of efforts to understand, design and act more sustainably, but there is much more that can be done than to build new buildings, create new degree programs and tout how much more sustainable a campus is this year than last. What is necessary is institutional transformation—not only new ways of doing things but new things to be done—in which the "inhabitants" are more than passive consumers and observers. Universities can reorganize their curricula, management and policymaking, and student activists and faculty supporters can become partners in such a process. This is possible only if institutional ecosystems are thoroughly mapped and their histories of development fully documented. In future work, the authors intend to further develop this approach to campus and city sustainability.

Acknowledgments The research for this article was supported by NSF–PIRE Award #1243536, PIRE: US-Denmark Cooperative Research and Education in Intermittency-Friendly Community Scale Renewable Energy Microgrids.

References

Alshuwaikhat, H. M., & Abubakar, I. (2008). An integrated approach to achieving campus sustainability: Assessment of current campus environmental management practices. *Journal of Cleaner Production*, *16*(16), 1777–1785. http://www.sciencedirect.com/science/article/pii/S0959652607002545 (Last Accessed December 06, 2015).

Arroyo, P. (in press). A new taxonomy for examining the multi-role of campus sustainability assessments in organizational change. *Journal of Cleaner Production*. http://www.sciencedirect.com/science/article/pii/S0959652615012019 (Last Accessed January 20, 2016).

Blanco, H., & Mazmanian, D. A. (2014). The sustainable city: Introduction and overview. In D. A. Mazmanian & H. Blanco (Eds.), *Elgar companion to sustainable cities-strategies, methods and outlook* (pp. 1–11). Cheltenham, UK: Edward Elgar.

Beringer, A., & Adomßent, M. (2008). Sustainable university research and development: Inspecting sustainability in higher education research. *Environmental Education Research, 14* (6), 607–23.

Bulkeley, H., & Castan Broto, V. (2012). Government by experiment? Global cities and the governing of climate change. *Transactions of the Institute of British Geographers*, *38*(3), 361–375. http://dro.dur.ac.uk/10434/1/10434.pdf (Last Accessed December 20, 2015).

Castan Broto, V., Allen, A., & Rapoport, E. (2012). Interdisciplinary perspectives on Urban metabolism. *Journal of Industrial Ecology*, *16*(6), 851–861. http://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2012.00556.x/abstract (Last Accessed April 17, 2016).

Center for Agroecology, & Sustainable Food Systems (CASFS). (2016). University of California Santa Cruz Farm and Garden Projects. http://casfs.ucsc.edu/about/History%20and%20News%20Archive/farm-and-garden-projects.html (Last Accessed February 02, 2016).

Christensen, P., Thrane, M., Herreborg Jørgensen, T., & Lehmann, M. (2009). Sustainable development: Assessing the gap between preaching and practice at Aalborg University. *International Journal of Sustainability in Higher Education, 10*(1), 4–20.

De Kraker, J., Cörvers, R., Valkering, P., Hermans, M., & Rikers, J. (2013). Learning for sustainable regional development: Towards learning networks 2.0? *Journal of Cleaner Production, 49*, 114–122.

Evans, J., Jones, R., Karvonen, A., Millard, L., & Wendler, J. (2015). Living labs and co-production: University campuses as platforms for sustainability science. *Current Opinion in Environmental Sustainability, 16*, 1–6.

Force, J. E., & Machlis, G. E. (1997). The human ecosystem Part II: Social indicators in ecosystem management. *Society & Natural Resources, 10*(4), 369–382.

Gallie, W. B. (1955). Essentially Contested Concepts. *Proceedings of the Aristotelian Society, 56*, 167–198.

Koester, R. J., Eflin, J., & Vann, J. (2006). Greening of the campus: A whole-systems approach. *Journal of Cleaner Production, 14*, 769–79.

Lipschutz, R. D. (2012). The sustainability debate: Déja Vu all over again? In P. Dauvergne (Ed.), *Handbook of global environmental politics* (2nd ed.). Cheltenham, UK: Edward Elgar.

Lipschutz, R. D. (1991). Wasn't the future wonderful? Resources, environment, and the emerging myth of global sustainable development. *Colorado Journal of International Environmental Law and Policy, 2*, 35–54.

Machlis, G. E., Force, J. O., & Burch, W. R., Jr. (1997). The human ecosystem Part I: The human ecosystem as an organizing concept in ecosystem management. *Society & Natural Resources, 10*(4), 347–367.

McFarlane, D. A., & Ogazon, A. G. (2011). The challenges of sustainability education. *Journal of Multidisciplinary Research, 3*(3), 81–107.

Ramaswami, A., Weible, C., Main, D., & Heikkila, T. (2012). A socio-ecological-infrastructural systems framework for interdisciplinary study of sustainable city systems. *Journal of Industrial Ecology, 16*(6), 801–813.

Snow, C. P. (1961). *Two cultures and the scientific revolution; rede lectures, 1959*. Cambridge: Cambridge University Press.

Trencher, G., Bai, X., Evans, J., McCormick, L., & Yarime, M. (2014). University partnerships for co-designing and co-producing urban sustainability. *Global Environmental Change, 28*, 154–165.

UCSC Regional Oral History Collection, & UCSC Library. (2003). The early history of UC Santa Cruz's Farm and garden: Interviews with Paul Lee, Phyllis Norris, Orin Martin, Dennis Tamura, interviewed by Maya Hagege, edited by Randall Jarrell. http://digitalcollections.ucsc.edu/cdm/compoundobject/collection/p265101coll13/id/3469 (Last Accessed February 06, 2016).

UCSC Regional History Project, & UCSC Library. (2008). Orin martin: Manager, Alan Chadwick Garden. http://escholarship.org/uc/item/0ng759sn (Last Accessed February 05, 2016).

UCSC Regional History Project, & UCSC Library. (2010a). Cultivating a movement: Organic & sustainable farming. https://library.ucsc.edu/reg-hist/cultiv/home (Last Accessed February 02, 2016).

UCSC Regional History Project, & UCSC Library. (2010b). Tim Galarneau: Activist and researcher, oral history transcript, UCSC Library. http://escholarship.org/uc/item/01w4f5n3 (Last Accessed February 02, 2016).

UCSC Sustainability Office Plans and Reports. http://sustainability.ucsc.edu/governance/plans-reports/index.html (Last Accessed January 31, 2016).

Valkering, P., Beumer, C., De Kraker, J., & Ruelle, C. (2013). An analysis of learning interactions in a cross-border network for sustainable urban neighborhood development. *Journal of Cleaner Production, 49*, 85–94.

Velazquez, L., Munguia, N., Platt, A., & Jorge Taddei, A. J. (2006). Sustainable University: What can be the matter? *Journal of Cleaner Production, 14*, 810–819.

The Role of Kenya's Formal Higher Education in Sustainable Development Within the Context of Globalization

Gladys Kivati

Abstract

In a developing nation like Kenya, an effective formal higher education system is essential for national development. The demand for university education in Kenya has increased in the past few decades. It is generally acknowledged that globalization has created tremendous impact on higher education in the twenty-first century. The paper seeks to determine whether the current education system in Kenya's formal higher education institutions is preparing students to address global sustainability challenges. To a large extent, most higher learning institutions in Kenya have remained local in their practice and operations and this sets a problematic precedence in the era of globalization. This paper analyses the impact of globalization on formal education system in Kenya, with a focus on higher education. It analyses the changes globalization has brought to the system and its influence in preparing people for sustainability challenges. The effect of globalization pressures on education, the socio-economic and inequalities that constitute justice and human rights are also examined. The paper concludes by reassessing the impact of globalization on education reform in Kenya.

Keywords

Sustainable development · Formal higher education · Globalization · Kenya

G. Kivati (✉)
London South Bank University, 103 Borough Road, London, UK
e-mail: gladynthenya@gmail.com; kivatig@gmail.com

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_2

1 Introduction

1.1 Purpose of the Paper

The paper set out to institute an up to date representation of higher education's system is preparing students to deal with globalization challenges and to formulate suggestions as to how the institution of higher education can maximise its involvement to sustainable development in Kenya. This is significant to the education sector, in particular higher education, due to its important role in imparting knowledge around sustainability issues through research and development. It is hoped that this paper will contribute to social, environmental and economic development for policy makers, teachers and students.

1.2 Background

In 2008, the government of the Republic of Kenya unveiled a comprehensive and ambitious development plan aimed at transforming the country into a middle-income economy by 2030 dubbed Kenya Vision 2030 (GoK 2007). On the other hand, a growing body of literature suggests higher education is a critical driver of economic growth and competitiveness (e.g. Bloom et al. 2006; Johnson 2002; Lin 2009; World Bank 2002). The World Bank has relied heavily on rates of return to education as the main rationale for educational investment (Rena 2007; Psacharopoulos 1994; World Bank 1995). A Taskforce on Higher Education and Society comprising of the World Bank and UNESCO developed a report on Higher Education in Developing Countries: Peril and Promise. The report highlighted that "The quality of knowledge generated within higher education institutions and its availability to the wider economy is becoming increasingly critical to national competitiveness" (TFHE 2000). This demonstrates the key role of higher learning institutions in training of creative, inventive and innovative individuals to produce products that enhance a nation's global competitiveness.

The Ministry of Higher Education, Science and Technology (MoEST) is responsible for improving the quality, relevance, equity and access to higher education and technical training. It is also mandated to enhance the capacity of the national Science Technology and Innovation (STI) system towards demand driven STI, quality higher education and technical education services (MoEST 2009). The vision of MoEST is to provide "quality education for development," while its mission is "to provide, promote and co-ordinate lifelong education, training and research for Kenya's sustainable development." Quality in Higher Education has become a primary agenda of countries worldwide. According to Cheng and Tam (1997), p. 23 education quality is "the character of the elements of input, process, and output of the education system that provides services that completely satisfy

both internal and external stakeholders by meeting their implicit and explicit expectation". There is, however a paradigm shift in higher education, from 'national' to 'global education,' from 'state controlled' to an 'open market economy,' from 'general education' to an 'educational system driven by market forces,' from 'one time education for a few' to 'lifelong education for all,' from 'teachers centred' to 'learner centred' education (Venkatasubramanian 2002).

This paper is divided into four broad sections. The first section examines the history and reforms on education system and with a focus of higher education in Kenya. The second section explores the context of globalization influence on education system, followed by a critical analysis of the impact of globalization on Kenya's formal higher education. The analysis in this section involves drawing upon illustrative cases from research where considerable writing on the subject has been undertaken. The analysis focuses on massification, accountability, privatization and marketization along with their implications for equality of opportunity, equity, quality and efficiency in higher education. This paper seeks to answer the question whether the current education system prepares learners to address global sustainability challenges. The paper concludes with an overview of the influence of globalization on Kenyan universities.

2 Reforming the Formal Kenyan Higher Education

2.1 The History and Reforms in Education Systems in Kenya

Education is the process through which skills and knowledge are conveyed with a purpose of integrating an individual into society, or changing the values and norms of a society (Wosyanju 2009). The structure of an education system comprises the levels characterizing that system, and the length of time a learner is expected to spend or the content of the curriculum expected to be covered at each level, in fulfilment of clearly articulated objectives (Koech 1999). Kenya is currently under the 8-4-4 (8 years in primary education, four year of Secondary education and 4 years of Higher learning education) system. Curriculum is the sum total of the learning opportunities presented to a learner by the environment, especially planned, organized and constructed for that purpose (Education Act, Cap. 211). As per the act, curriculum is further defined as a plan for providing learning opportunities and experiences to our learners to achieve educational goals and specific objectives for the Kenyan society. The Kenya Vision 2030 is the national long-term development blue-print that aims to transform Kenya into a newly industrializing, middle-income country providing a high quality of life to all its citizens by 2030 in a clean and secure environment. The Vision comprises of three key pillars: economic; social; and political aspects. The working definition of globalization in this paper is derived from Cheng (2000), who refers to globalization as the transfer,

adaptation, and development of values, knowledge, technology, and behavioural norms across countries and societies in different parts of the world.

Progress in the reforming of education system has so far been made in realization of Vision 2030 goals as it is based on leveraging creative learners capable of raising Kenya's international competitiveness. A task force was launched on 2nd February 2011 by the Ministry of Education to review and align the education and training sector to the Constitution of Kenya 2010 and Kenya Vision 2030, and to position education and training accordingly at the county, national, regional and global levels. The task force criticized the current 8-4-4 education system and recommended implementation of a new 2-6-6-3 structure of education with 2 years of Pre-primary, 6 years of Primary (3 years lower and 3 years upper), 6 years Secondary (3 years junior and 3 years senior), and a minimum 3 years University of higher education. According to the task force, the new system would focus on child development, skills and competencies to be learnt from early childhood to University level (MoE 2012a, b). It argues that the competencies and skills will enable the learners to meet the human resource aspirations of Kenya Vision 2030 by offering a choice of subjects and career pathways. The proposed structure of education is described to be all- inclusive, flexible and coordinated compared to the current system and is meant to provide opportunities for lifelong learning and achieving goals of Education for All (MoE 2012a, b).

2.2 Rise and Expansion of Higher Education in Kenya

Higher education in Kenya can be traced back to 1922 when the then Makerere College in Uganda was established as a small technical college which was then expanded to meet the needs of the three East African countries i.e. Kenya, Uganda, and Tanganyika and Zanzibar, as well as Zambia and Malawi. In the 1940s and early 50s, only Makerere college was providing university education in East Africa. This lasted until 1956 when the Royal Technical College was established in Nairobi. In 1963, the Royal Technical College became the University College, Nairobi, following the establishment of the University of East Africa with three constituent colleges in Nairobi, Dar es Salaam and Kampala (Makerere). The University of Nairobi was thus established as the first university in Kenya. The intervening decades were characterized by continuous growth in demand (MoE 2012a, b; Oanda and Jowi 2012; Odhiambo 2011; Sifuna 2010). Kenya currently has twenty two public universities with several constituent colleges and campuses, and seventeen chartered private universities also with a number of constituent colleges. In addition, Kenya has several technical, industrial, vocational, and entrepreneurship training institutions, hereafter referred to as non-university institutions (MoE 2012a, b). All Kenyan public universities have experienced rapid growth and expansion aligned with the governmental goals to improve equity, the economy, and the educated populace (Hughes and Mwiria 1990).

2.3 Context of Globalization Influence on Kenya's Higher Education System

The pressure originating from a changing global higher educational landscape has had an impact on the delivery of educational services due to economic, technological, political, cultural, and scientific trends placing new demands on Kenya's education system. As a result, the education system in Kenya has increased its investment in higher learning institutions in research and development (R&D) activities with potential to foster growth in a globalized knowledge economy. An OECD publication argues that: 'Higher Education drives and is driven by globalization (OECD 2009). It continues to explain that higher education trains skilled workers and contributes to the research base and capacity for innovation that determine competitiveness in the knowledge-based global economy while facilitating international collaboration and cross-cultural exchange. The cross-border flow of ideas, students, faculty and financing, coupled with developments in information and communication technology, are changing the environment where higher education institutions function' (OECD 2009).

The Government of the Republic of Kenya acknowledges that higher education influences economic competiveness and plays a social role in the context of globalization. It is now well recognized that the growth of the global economy has increased opportunities for those countries with good levels of education and vice versa (Carnoy 1999; Tilak 2001). This has induced environmental and cultural outcomes and graduates are viewed as the driving force in promoting economic progress and social welfare.

3 Methodology

The method employed in this study incorporated a background analysis and a review of literature from current research and publically available information. Due to the scope of the paper and the nature of the approach used, the results are not entirely representative, but they offer a rough idea on the status of globalization influence to the higher education sector. More detailed and quantified studies could be carried out, coupled with surveys and in-depth analysis, when resources are available at a later stage.

4 Results

4.1 Impacts of Globalization on the Higher Education System

Currently, the processes of globalization has serious consequences for transforming teaching and learning as manifested in massification, accountability, privatization

Table 1 Synthesis of the impacts of globalization

Impact	Indicator	Influence on higher education sector
Massification in higher education institutions	Expansion in higher education	Reduced quality of education for the graduates
	Inequality in educational opportunity	Minority not taken into consideration
	Inadequate human resources	Challenges of reforms and change Implementation
Student mobility	Increased number of students studying abroad	Brain-drain in Kenya
University ranking (Kenyan universities in the world)	Increased competitiveness (among Kenyan universities, and with the other universities in the world)	Focusing on present needs market (to enhance the profile/competitiveness of the specific university)
Marketization of education	Unionization University entrepreneurship	Interrupted learning Minority are not considered Focus on current market needs
Accreditation for quality assurance	Increased diversity and complexity in higher education	Competitive higher education institutions
Accountability	Incorporation of strategic planning by higher education institutions	Preparing holistic education systems with monitored outcomes/outputs
Information, and communication technology	Mixed education delivery systems in higher education	Reduced transmissive teacher centered approach

and marketization of universities, all which have had considerable impact on equality of opportunities, equity, quality and efficiency of Kenya's higher education. The impacts are summarized in Table 1 and will be developed in the next points.

4.1.1 Massification in Higher Education Institutions

The term 'massification in higher education' is used to describe massive increase in student numbers in the higher education institutions and the growth of enrolment beyond the level of academic reproduction and training (Altbach 1982). Scott (1995) used the term massification in the context of higher education systems to describe the rapid increase in student enrolment in the latter part of the twentieth century. Trow (2000) described massification using the terms elite, mass and universal higher education, with elite representing a national enrolment ratio of up to 15 %, mass representing a ratio of up to 50 %, and universal a ratio inexcess of 50 %.

Rapid Expansion in Higher Education As a signatory of international education declarations and conventions such as Education for All (EFA), the EFA Dakar Framework of Action (2000), the Millennium Development Goals (2000), and the

Sustainable Development Goals (2015), the Government of Kenya is obliged to provide education for all citizens, eliminate all forms of discrimination, and improves access to education in alleviating poverty. These obligations have had an impact on the education system such as increased enrolment in basic education, leading to increased enrolment in the higher education institutions. The global forces resulting from international agreement passed has led to a large number of graduates as a means of meeting the labour market demands to enhance Kenya's global competitiveness. The consequence of these development have impacted the quality of education as there is no system for tracking the return on investment on the graduates at completion.

Inequality in Educational Opportunity University massification due to globalization has had a negative impact on equality of opportunities in higher learning institutions. According to the Education For All (EFA) Global Monitoring Report by UNESCO (2005), education inequality between the 'haves' and 'have-nots' in Kenya is overwhelming (UNESCO 2005). While actual enrolments have increased, class- based disparities in access to university education have also become apparent. The grouping of government-sponsored and privately—sponsored students has led to a division of the student body in classes. Self-sponsored enrolments rely on ability to cover the costs since educational loans are not readily available to such students in Kenya. For the small percentage of students who persist through the primary and secondary school systems, they face challenges in the higher education admissions' process and financial barriers that create more obstacles in education access. In 2007, for example, of the 82,000 students who were deemed officially qualified for university admission on the basis of their KCSE results (out of the 276,000 students who took the examination), only 10,000 were selected for government sponsorship, 10,000 entered university on a self—paying basis and 5000 entered the private sector, leaving 57,000 qualified students unable to enter higher education (Munene and Otieno 2008). The system then becomes one where, it is not just the best and brightest who attend university, but often the richest or those with financial means (Yakaboski and Nolan 2011). These patterns are detrimental for a country that wants to participate in the global market and to shift reliance from donors and funding agencies to an internal economy.

Human Resource Management The faculty in private universities is mostly part-time, while in public universities, departments with massive enrolment and partnership colleges have had to rely on part time instructors as well (Mageto 2001). These faculty differentiation conditions have resulted from massification impacting on the quality of education provided by the part time lecturers as they are given substandard treatment. The large numbers being realized out of the education system at the graduate level are potential candidates for the education profession (Barnes and O'Hara 1999) with difficulty to obtain full-time appointments due to the high supply that supersedes the demand hence resulting to part time lecturing. Educationists have argued that the rise in student enrolment was implemented without specific staff recruitment and expansion or upgrades of learning resources at

the universities, thus adversely affecting the quality of education in public universities (Gudo 2014).

4.1.2 Increased Student Mobility

One of the aspects of globalization is student mobility, where the Kenyan Ministry of Education, Science and Technology in collaboration with international universities, award scholarships to Kenyan students to study abroad contributing to the mobility. Student mobility is an instrument for personal development enhancing competencies that contribute to the economy and society (Jos et al. 2012). Established partnerships with academic institutions in other countries offers opportunities for different academic programs, research projects develop, and collaborations in a variety of ways. This offers Kenyan students and scholars opportunities in a globalized higher education environment. However, reports show that less than 30 % of Kenyans return and there are over a million Kenyans living and working overseas (Siringi and Kimani 2005). The implication of this to the Kenyan economy is that the Kenyan government has invested significant human resources into the students studying abroad yet so few of them will return to invest back into the Kenyan economy unless they are encouraged and rewarded. Without significant investment in skilled job development that comes with appropriate and increased level of salary, then there will be limited economic attraction for students to return.

4.1.3 Ranking of Kenyan University Among Global Recognized Universities

As stated in Standard Newspaper, 2 August 2014, p. 15, The Times Higher Education World University released its 2012–2013 universities and college's rankings and Kenyan universities are prominently featuring based on teaching, research, knowledge transfer and international outlook. The list featured University of Nairobi as the top ranked in Kenya and 17th in Africa. As a factor of the pressure from the rankings, greatly tied to globalization, rankings become an impact to the higher education sector with potential ripple effects including competitiveness. As much as the ranking encourages informed policy making and use data for decision-making purposes documenting student and institutional success (IHEP 2009), it has an impact on the education system as there is a strong risk that in trying to improve their position in the rankings, universities are tempted to enhance their performance only in those areas that can be measured by ranking indicators (Rauhvargers 2011).

4.1.4 Marketization of Education

Historically, it is important to note that after independence, Kenya's higher education was free as the government desired to train a truly Kenyan workforce to replace the departing British administrators and the government wanted to improve access (Wangenge-Ouma 2007). The free higher education program lasted until 1974 when the government introduced a student loan "scheme" or program created

to help cover non-tuition costs. This program was unsuccessful partially because the government had not developed a repayment process so the default rate was 81 % by 1987 (Otieno 2004).

Higher education institutions in Kenya are forced to diversify their sources of revenue to and optimize their revenue portfolio through market-oriented academic programmes and various commercialization activities (Kiamba 2004). Clark (1998) notes that the emergence of 'entrepreneurial activity' is a clear characteristic of global transformation in higher learning institutions. The shrinking allocation to public universities has led to insufficient facilities and stalled infrastructural projects in many universities in the country (Wangenge-Ouma 2007).

The private institutions are not any better since they depend on the tuition fees they generate from their students for their revenue; and such heavy dependence on tuition coupled with lack of alternative income sources have made these institutions expensive and thus unaffordable for most Kenyans, in effect, limiting their services to those of high socio-economic status. The higher learning institutions therefore charge fees strictly in accordance with market forces on the basis of full cost recovery (Ngome 2003).

This has great impact on the nature on the social role of the education system. This was further emphasized in the Master Plan on Education and Training 1997–2010 (GoK 1981). The document stated that:

> Universities will be encouraged to develop non-public sources of their revenues, including income-generating activities (such as returns from research and consultancies with industry and employers, services to the community, agro-based production, manufacturing for the market, including making equipment for use in schools, hiring out university facilities); grants and donations from NGOs and well-wishers; and funding from alumni (p.110).

Since the late 1990s the University of Nairobi, along with other public universities, have embarked on a program of entrepreneurial activity. For instance the University of Nairobi has incorporated a holding company, University of Nairobi Enterprises and Services Limited (UNES), as well as invested in consultancy services, conference facilities, restaurants, lodging facilities and bookstores as primary revenue generating sources. Since academics have to align their work to the market, there has been a heightened urge for academic to either unionize where unions are absent or reinvigorate existing ones. In Kenya, the need to grant more power to the academic resulted in the registration of the University's Academic Staff Union (UASU) in 2003 after a 24-year proscription by the state. In 2004 UASU organized a nationwide strike involving all academics in public universities over terms and conditions of service including salaries (Sall 2004). These incidents of institutional instability have a detrimental effect on internal efficiency in university operations.

4.1.5 Accreditation for Quality Assurance

During the World Education Forum held in Dakar in 2000, Kenya among other countries committed themselves to improving the quality of all aspects of education as it is one of the goals in achievement of EFA. This had a positive impact on the education system in Kenya since it strives to be globally competitive and to cope

with the changing context, diversity and complexity in higher education system, there is need to assure and ensure the quality of higher education nationally. This has been achieved through establishment of Directorate of Technical Accreditation and Quality Assurance mandated with ensuring and maintaining education standards in Kenya (Commission for Higher Education 2012).

4.1.6 Accountability

In order to ensure Kenyan Universities are globally competitive, new bureaucratic structures have increased importance of accountability to monitor adherence to performance indicators in universities. In Kenya, for instance, under the State Corporations (performance contracting), the Government requires all state corporations (including universities) to sign performance contracts with the government and submit quarterly performance reports. In response, Kenyatta University established the Center for Quality Assurance to monitor the quantity and quality of work output by academics. Moreover, by 2004, virtually all African universities had adopted strategic planning as a vital tool in navigating an increasingly competitive environment and ensuring accountability.

Kenyatta University in Kenya further embarked on its first strategic planning 2005–2014 aimed at transforming the university into a world-class institution, globally connected through partnership and information technology, research-oriented and training labour-ready graduates who are creative and independent thinkers among others (Kenyatta University, Strategic Plan, 2005–2010). The accountability is aimed at increasing effectiveness and service delivery of the education system of Kenya.

4.1.7 Information and Communication Technology (ICT)

Information and communication technologies have created a universal environment of instantaneous contact and of simplified scientific communication (Altbach et al. 2009). In Kenya, training opportunities such as mixed mode of delivery (face-to-face and Distance Education) have also been provided using information and communication technology. The emergence of distance learning as the effective supplementary system to the traditional universities and colleges is also an important trend in the expansion of the higher education system. Currently, such learning approaches are in use in major universities in Kenya.

4.2 Is the Current Education System Preparing People to Address Sustainability Challenges?

"*Sustainability*" in this context implies that the critical activities of a higher education institution are ecologically sound, socially just and economically viable, and that they will continue to be so for future generations. Sustainability and Sustainable development will be used interchangeably.

Kenya faces a number of sustainability challenges ranging from economic, societal, environment and these challenges are interlinked. The societal issues

encompass poor governance, corruption, gender inequality, HIV/AIDS, erosion of cultural values, drug abuse, and human rights abuse among others. The economic challenges include poverty, wide gap between the rich and poor, poverty, inadequate investment in infrastructure, unemployment, corruption, lack of accountability among others. The environmental challenges include loss of biodiversity, poaching, climate change and variability, loss of forest cover, and land degradation. The goal of Kenya Vision 2030 is to have a nation living in a clean and secure and sustainable environment. As discussed, the education system in Kenya has been impacted greatly in its quest to be globally competitive. As a result, several gaps have emerged in the current education system.

4.2.1 Education Structure

The current education structure, which is the 8-4-4 structure, does not cover early childhood education (Cheserek and Mugalavai 2010). Early childhood education is the starting point for lifelong learning and the years are crucial for child development and learning. As commented by Sterling (1996), educating children whilst still young is vital, since it encourages the children to develop a questioning attitude to received wisdom. This will prepare them for sustainability challenges and globalization impacts even as they advance in higher education.

4.2.2 Preparing Students to Deal with Globalization Trends and Inculcating Transferable Skills

The education system in higher learning institution presents students with ready-made problems (Chacha 2004). This does not prepare them to deal with the changing dynamics of the external forces brought forth by globalization. To prepare student for sustainability challenges, the education system should focus on problem-based learning to prepare students for life-long learning. Steinemann (2003) comments on the context for problem-based learning with emphasis on learning by doing. He reiterates that this gives students a motivating context for learning as they take ownership of a problem and the problem solving process (Steinemann 2003). This is further emphasized in Allan (2006) where he stresses the importance of thoughtful reflection by learners to ensure that each learning outcome is clearly described and operationalized (Allan 2006) and that conceptual links between higher education and the labour market, in terms of the knowledge, skills, and competencies, are clear. As graduates go to the world of work, they should have the capacity to make decision based on complexity associated with uncertain global realities. Atkinson (2000), also further notes that sustainability, will not come from ''ready-made solutions.' The education system should allow all learners to transit from one level to the other until they are 18 years of age. In addition, a suitable structure should be flexible and provides limitless opportunities for lifelong learning for all.

4.2.3 Minority not Taken into Consideration

Admission policies in higher learning institutions do not have a criterion for attracting students from disadvantaged families, gender and communities which are

underrepresented. Every individual goes through the same competitive degree programme selection and this impacts access and equity in selection especially for subjects such as engineering, law and science. Gender stereotypes and cultural norms still exist in Kenya which affects selection of certain degree programmes by women. While actual enrolments have increased, class-based disparities in access to university education have also become apparent (Munene and Otieno 2008). Research indicates that educating women influences many sociocultural and socioeconomic indicators including health care, infant mortality, and reducing population grown.

4.2.4 Challenges of Reforms and Change Implementation

There is failed systematic follow up and implementation of recommendations from review committee leading to skepticism of the government's will for reforms by Kenyans. In addition, there is inadequate capacity and resources for implementation and lack of political will to take unpopular but necessary decisions. There have been several review and recommendations made by the taskforce formed by the government but it is still not willing to implement hence reforms in the education system are at a standstill.

4.2.5 Transmissive Teacher Centered Approach

The current educational system in higher learning institutions, in its present state, is not suitable to teach sustainability, as it is a very transmissive, teacher-centered approach with an emphasis on cognitive learning and memorization (Sterling 2002). The process of curriculum design and development at the university level is left to individual universities (MoE 2012a, b). In Kenya there has been the problem of tending to emphasize on certification at the expense of education and skills acquisition with more school-leavers and non-university graduates in labour force hurry for university education, training and learning to boost their chances in the labour market (Ojiambo 2009; Fortunate 2013).

Many of the activities appear to be administratively designed and implemented, rather than being participative and inclusive of the students—thereby minimizing meaningful, real learning opportunities. The state has little or no control over the teaching, research and learning activities going on in the Universities. The multiplication of these institutions through establishment of subsidiary campuses has meant a demand for more human power. There is therefore a shortage of academic staff and the implication is that most lecturers are master's degree holders with no research and teaching experience. Hence there is a necessity for the kind of learning that goes into the depth of things and brings about a paradigmatic shift—a shift from a transmissive to a transformative learning model (Burns 2011; Cress 2004).

4.2.6 Focus on Present Market Needs

The current education system is focused in meeting current market needs with higher education systems becoming like corporates (Cheserek and Mugalavai 2010). Scott and Gough (2006) comments "too close a focus on society's present expectations for the future—based on presently available knowledge—may have

the effect of limiting that future, through a failure to encourage students to test or challenge those expectations'' (p. 93). The emphasis of economic gains at the expense of environmental and social understanding hinders the current system from preparing students to deal with sustainability challenges. There has been increased faculty differentiation based on disciplinary specialization. Those in highly marketable disciplines mentioned above, have been viewed as more desirable than their counterparts in traditional academic programs. In tandem with the perceived market value of various disciplines, Kenya's Nairobi and Moi Universities have instituted a differentiated salary structure in which part-time instructors in highly marketable disciplines are paid at a higher scale than their counterparts in disciplines viewed as lacking in market potential. Differential pay based on discipline is one of the leading contributors to institutional tensions thereby lowering the overall efficiency of a university's operations.

5 Conclusion

The paper concludes that the multiple and diverse responsibilities of higher education are ultimately key to the well-being of Kenya, but this expanded role adds considerable complexity and many new challenges. The transformative process of globalization in which the national competiveness in the global arena has become significant to the extent that it informs national policy agendas. At the same time, globalization has had an impact on formal higher education system in Kenya. As such, Kenya is set to profit from the opportunities and gains opened up by positive globalization impacts on the beneficiaries.

However challenges such has unequal distribution of education achievement to most part of population will hinder them from gaining less or even lose out in the process of globalization as well as prepare its citizens to deal with sustainability challenges. The Kenyan people are well aware that the achievement of Kenya Vision 2030 depends heavily on science, technology and innovation, however, the current education system leaves little room for development of technical education, innovativeness and identification of individual talents. Unstoppable globalization will oblige institutions to rethink traditional degree programmes and past pedagogies, so as to prepare increasingly diverse student cohorts for a borderless economy. This can be equilibrated by setting policies so to guarantee sustainability of globalization to ensure that everyone acquire lifelong learning education that will enable them be capable to adopt new technologies and deal with the rapidly changing conditions that globalization brings about.

Even so, higher education is under difficulty to meet up with growing expectations, be it in regard to student statistics, preparation for educations, workforce requirements, or economic development. As evident the resources for sustaining these institutions are likely to decline. With all these challenges there is need to foster education for sustainability by focusing on new models that focuses on students experience, innovation that will guarantee that higher education keeps on

meeting society's needs. With a focus of a sustainable future, education in higher learning institutions should aim at imparting sustainability values and norms through give emphasis to collaborative efforts as well as encouraging practices that promote sustainability. In order to deal with the complexities of globalization, values and normative aspects of sustainability are entrenched in key competencies that promote education for sustainability—systems thinking proposes that we observe ourselves as a part of the environment, not detached from or ruling over nature; engagement of stakeholders and group collaboration that encourages considerate addition and representation of varied opinions; foresighted visioning that put emphasis on equity among generations, therefore placing a significance on the future generation needs and, finally, action-orientation which depicts the need to weigh up our assumptions, and calls us to reflect on our actions and adjust our choices based on changes in education system brought by globalization. The shift to educating for sustainability might be slow but it should be followed consistently. Educators can embark on imbedding competencies and pedagogies of sustainability gradually, while making headway and acclimatizing to a novel way of Higher learning education in light of shifting circumstances brought about by globalization.

References

Allan, J. (2006). Learning outcomes in higher education. *Studies in Higher Education*, *21*(1), 93–108. Routledge.

Altbach, P. (2000). The deterioration of the academic estate: International patterns of academic work. In P. Altbach (Ed.), *The changing academic workplace: Comparative perspectives* (pp. 1–23). Massachusetts: Boston College Center for international Higher Education.

Altbach, P. G. (1982). Reform and innovation in higher education: Introduction. Educational Documentation and information, Bulletin of the International Bureau of Education, No. 223.

Altbach, P. G., Reisberg, L., & Rumbley, L. E. (2009). *Trends in global higher education: Tracking an academic revolution*. Oxford University Press.

Atkinson, E. (2000). In defense of ideas, or why 'what works' is not enough. *British Journal of Sociology of Education*, *21*, 317–330.

Barnes, N., & O'Hara, S. (1999). Managing academics on short term contracts. *Higher education Quarterly*, *53*(3), 229–239.

Bloom, D., Canning, D., & Chan, K. (2006). *Higher education and economic development in Africa*. Harvard University, Word express.

Burns, H. (2011). Teaching for transformation: (Re) Designing sustainability courses based on ecological principles. *Journal of Sustainability Education*. Oxford University Press.

Carnoy, M. (1999). Globalization and educational reform: What planners need to know, Report No.63, International Institute of Educational Planning, Paris.

Chacha, N. (2004). Reforming higher education in Kenya challenges, Lessons and opportunities. State University of New York workshop with the Parliamentary Committee on Education, Science and Technology. Naivasha, Kenya

Cheng, Y. C., & Tam, W. M. (1997). Multi-models of quality in education. *Quality Assurance in Education, 5*(1), 22–31. doi:10.1108/09684889710156558

Cheng, Y. C. (2000). A CMI-triplization paradigm for reforming education in the new millennium. *International journal of educational management*, *14*(4), 156–174

Cheserek, G. J., & Mugalavai, V. K. (2010). Challenges and reforms facing Kenyan education system in the 21st century: Integrating the principles of vision 2030 and constitution 2010. *Journal of Emerging Trends in Educational Research and Policy Studies.*

Clark, B., & Neave, G. (Eds.). (1992). *The encyclopedia of higher education: Volume 1 national system of higher education*. Oxford: Pergamon Press.
Clark, B. R. (1998). *The entrepreneurial university*. Oxford. Pergamon Press.
Commission for Higher Education Nairobi. (2012). Accreditation and Quality Assurance Report July 2006 to June 2012. Author.
Court, D., & Ghai, D. (Eds.). (1974). *Education, society and development: New perspectives from Kenya*. Nairobi: Oxford University Press.
Cress, C. (2004). Critical thinking development in service-learning activities: Pedagogical implications for critical being and action. *Inquiry: Critical Thinking Across the Disciplines, 23*, 87–93.
Eshiwani, G. (1993). *Education in Kenya since independence*. Nairobi: East African Educational.
Fortunate, E. (2013). New law wants varsities to walk the quality talk. Daily Nation, Nation Media Group, A Media of Africa for Africa. http://www.nation.co.ke/Features/DN2/Dirty-survivaltactics-as-some-varsities-struggle/-/957860/1617234/-/12y3rxf/-/index.html. Retrieved July 28 Monday, 2015.
GoK. (1981). Second University in Kenya. Report of the Presidential Working Party. Nairobi: Government Printer. Government Press.
GoK. (2007). Ministry of Planning and National Development, 2007: Kenya Vision 2030.
Gudo, C. (2014). Kenya financing higher education in Kenya: Public—Private partnership approach. *International Journal of Educational Policy Research and Review*, *1*(1), 001–005.
Hughes, R., & Mwiria, K. (1990). An essay on the implications of university expansion in Kenya. *Higher Education, 19*, 215–237.
IHEP. (2009). *Impact of college rankings on institutional decision making: Four county case studies*. Retrieved July 20, 2015 from http://www.ihep.org/publications/publications-detail.cfm. Income Generating Activities at the University of Nairobi. *Journal of Higher Education*.
Johnson, J. M. (2002). The reverse brain drain and the global diffusion of knowledge. *Georgetown Journal of International Affairs*, *3*(2), 125–131.
Jos, B., D. Wit, & et al. (2012). *Internationalisation revisited: New dimensions in the internationalisation of higher education*. Columbia University Press
Kiamba, C., (2004). Privately sponsored students and other income generating activities at the University of Nairobi. *Journal for Higher education in Africa, 2*, 55. Columbia University Press.
Kenya Government. (1998). *Master Plan on Education and Training 1997-2010*. Nairobi: Jomo Kenyatta Foundation.
Kenya Government. (2004). Sessional Paper No. 1 of 2004 on a Policy Framework for Education, Training and Research: Meeting the Challenges of Education, Training and Research in the 21st Century, January, Nairobi: Government Printer.
Kenya National Commission for UNESCO. (1992). Report on the National Conference for Education For All (EFA) 1991–2000 and Beyond. Government Press. Kenyatta University, Strategic Plan 2005–2010, Nairobi: Kenyatta University Office of the Vice Chancellor.
Kiamba, C. (2004). Private sponsored students and other income-generating activities at the University of Nairobi. *Journal of Higher Education in Africa., 2*(2), 53–73.
King, K., & MacGrath, S. (2002). Globalisation, enterprise and knowledge: Educational training and development. *International Review of Education*, *50*(1), 74–76. Oxford Press.
Koech, D. K. (1999). *Report on the commission of inquiry into the education system of Kenya: Totally integrated quality education and training*. Government Press.
Lin, O. C. (2009). Bridging university and industry: Taiwan's model of a national innovation system. In J. A. Douglass, C. J. King, & I. Feller (Eds.), *Globalization's muse: Universities and higher education systems in a changing world* (pp. 299–314). Berkeley, CA: Public Policy Press/Center for Studies in Higher Education.
Mageto, P. (2001). *Corporate and personal ethics for sustainable development: Experiences, challenges and promises of part—Time teaching in selected universities in Kenya*. Daystar University, School of Arts and Humanities.

Ministry of Education (MoE). (2012). A policy Framework for education and training. Reforming Education training in Kenya. Government Press.
Ministry of Education (MoE). (2012b). *Towards a globally competitive quality education for sustainable development*. Nairobi: Author.
Ministry of Education, Science and Technology. (2009). *About the Ministry*. Retrieved July 01, 2015 from http://www.scienceandtechnology.go.ke/
Munene, I., & Otieno, W. (2008). Changing the course: Equity effects and institutional risk amid policy shift in higher education financing in Kenya. *Higher Education, 55*, 461–479.
National Economic and Social Council of Kenya (NESC). (2007). *Kenya Vision 2030*. Retrieved July 30, 2015 from http://www.investmentkenya.com/Documents/Publications/Vision_2030_BROCHURE
Ngome, C. (2003). Kenya. In D. Teferra & P. G. Altbach (Eds.), *African higher education: An international reference handbook* (pp. 359–371). Bloomington: Indiana University Press.
Oanda, I. O., & Jowi, J. (2012). University expansion and the challenges to social developments in Kenya: Dilemmas and pitfalls. *Journal of Higher Education in Africa, 10*(1), 49–71.
Odhiambo, G. O. (2011). Higher education quality in Kenya: A critical reflection of key challenges. *Quality in Higher Education*, *17*(3), 299–315.
Odour, A. (2014). University of Nairobi ranked the best learning institution in Kenya' Standard Newspaper. 13th February. P15
OECD. (2009). *Internationalization of Higher Education: A Policy Brief*. Ojiambo: OECD.
Ojiambo, P. O. (2009). Quality of education and its role in national development: A case study of Kenya's educational reforms. *Kenya Studies Review*, *1*(1), 133–149.
Ominde, S. H. (1964). Kenya education commission report. Republic of Kenya. Nairobi: Government Printers.
Otieno, W. (2004). Student loans in Kenya: Past experiences, current hurdles, and opportunities for the future. *Journal of Higher Education in Africa, 2*(2), 75–99.
Owino, G. C. (1997). Vocational educational in primary schools in Kenya and Tanzania. A comparative study with special reference to Kenya. Eldoret.
Psacharopoulos, G. (1994). Returns to investment in education: A Global update. *World Development, 22*, 1325–1343.
Rauhvargers, A. (2011). Global university rankings and their impact. Retrieved June 18, 2015 from http://www.eua.be/pubs/Global_University_Rankings_and_their_Impact.pdf
Rena, R. (2007, April). Higher education in Africa—A case of Eritrea. *New Delhi: Journal of Educational Planning and Administration*, *21*(2). 125–140 (A Quarterly Journal Published by the National University of Educational Planning and Administration).
Republic of Kenya. (1976). *The national committee on educational objectives and policies (Gathachi Report)*. Nairobi: Government Printer.
Republic of Kenya. (1964). *Kenya education commission report, part I*. Nairobi: Government Press.
Republic of Kenya. (1981). *Second university: Report of presidential working party (Mackey Report)*. Nairobi: Government Printer.
Sall, E. (2004). Alternative models to traditional higher education: Market demand, networks, and private sector challenges. *Journal of Higher Education in Africa, 2*(1), 182.
Sawyerr, A. (2002). *Challenges facing African universities: Selected issues*. Paper presented at the 45th Annual Meeting of the African Studies Association, 5–8 December, Washington, DC.
Scott, P. (1995). The meanings of mass higher education buckingham SRHE: Open University Press.
Scott, W., & Gough, S. (2006). Sustainable development with UK higher education: Revealing tendencies and tensions. *Journal of Geography in Higher Education, 230*(2), 293–305.
Sheffield, J. R. (1973). *Education in Kenya: A historical study*. New York: Teachers College.
Sifuna, D. N. (2010). Some reflections on the expansion and quality of higher education in public universities in Kenya. *Research in Post-Compulsory Education*, *15*(4), 415–425.

Simiyu, J. W. (2001). *Factors, which influence the teaching of technical and vocational subjects in primary schools in Uasin Gishu, district*. Eldoret: Moi University (Department of educational communication). MA dissertation (unpublished).
Siringi, S., & Kimani, M. (2005). Kenya: Leading in brain drain. The Nation. Retrieved July 29, 2015 from http://www.afrika.no/Detailed/11015.html
Steinemann, A. (2003). Implementing sustainable development through problem-based pedagogy and practice. *Journal of Professional Issues in Engineering*. Columbia University Press
Sterling, S. (2002). *Education for sustainable development: The challenge of reorienting education keynote lecture to Ministers of education Meeting, Baltic Agenda 21, Haga Palace, 25th January*. Stockholm: Unpublished.
Sterling, S. (1996). Developing strategy. In J. Huckle, & S. Sterling (Eds.), *Education for sustainability*. London: EarthScan.
The Task Force on Higher Education and Society (TFHE). (2000). *Higher education in developing countries: Peril and promise*. Washington DC: World Bank.
Tilak, J. B. G. (2001). Education and globalisation: The changing concerns in economics of Indian education, editorial, perspectives in education. *17*(Special Issue), 5–8.
Trow, M. (2000). From Mass higher education to universal access: The American advantage. Research and Occasional Paper Series, Center for Studies in Higher Education. UC Berkeley.
UNESCO. (2004). Education inequality at school and education policies. Paris: UNESCO.
UNESCO. (2005). *Education for all; The quality imperative*. Paris: UNESCO.
Venkatasubramanian, K. (2002). *Financing of higher education, the Hindu*. ICFAI University Press.
Wangenge-Ouma, G. (2007). Higher education marketization and its discontents: The case of quality in Kenya. *Higher Education, 56*, 457–471. doi:10.1007/s10734-007-9104-2
World Bank. (1995). *Policies and strategies for education: A world bank review*. Washington, DC: World Bank.
World Bank. (2002). Constructing knowledge societies: New challenges for tertiary education. Washington, DC.
World Bank. (2004). Facilitating Investment in the Global Education Market. Washington, DC: World Bank.
Wosyanju, C. (2009). The system of education in Kenya, Retrieved July 26, 2015 from http://international.iupui.edu/kenya/resources/Education-in-Kenya.pdf
Yakaboski, T., & Nolan, K. (2011). The Kenyan school systems impact on public higher education access: Examination of growth, access, and challenges. *Journal of International Education and Leadership*, *1*(1).

Author Biography

Gladys Kivati holds a Masters of Science degree in Education for Sustainability from London South Bank University, and a Bachelor of Science degree in Environmental Studies and Community Development from Kenyatta University, Kenya. She has also received a Diploma in Project Management. Gladys is certified in three global cross cultural tools which are: Globe Smart Leadership Assessment, Globe Smart Profile and Globe Smart Global Teaming Assessment. Gladys' core skill areas are enhanced by specialization in working in multicultural environments. Ms. Kivati has engaged with various sectors internationally and in Kenya, including UN agencies, private sector, entrepreneurs, NGOs and IGOs as a Sustainability Consultant. Gladys has actively been involved in various projects promoting Education for Sustainable development in Kenya such as Education for Sustainable Development in Africa project by United Nations University aimed at developing a Master graduate level course in Education for Sustainable development in Kenyan Universities, Imarisha Naivasha Project, EcoSchools projects and an active stakeholder in the Regional Centre of Expertise Greater Nairobi.

Sustainable Development at Universities as Viewed Through the Lens of the PROMISE Framework for Sustainability

Camélia Dumitriu

Abstract

The purpose of this article is to explore how North American business schools integrate the concept of 'sustainable development' in their graduate business curricula, how their curricula serve students' needs for sustainability-related knowledge and the avenues by which this knowledge is transmitted and acquired. A 'purposive' sample was used—the North American business schools in Aspen Institute's "Top 100 ranking", which ranks those MBA programs and business schools throughout the world that "work to integrate the social, environmental and economic realities of business into management teaching and research." The final sample was a 'saturation sample' made of forty schools. Based upon the term of "education for sustainability" (UNESCO 2014), data was collected through their Websites and from their program' brochures. Their graduate curricula and the content of all of their graduate courses were analyzed in order to identify sustainability-related topics. Then, the data was sorted by category according to the PROMISE Framework's dimensions of sustainability (developed at MIT Sloan School of Management and Jay 2014). The paper presents the descriptive statistics of the programs, courses and sustainability-related topics. Then, the implications for theory building and curriculum development, as well as ways to achieve transferability of the results, are discussed.

Keywords

Sustainable development (SD) · Education for sustainability (EFS) · North American business schools · Graduate business curricula

C. Dumitriu (✉)
Department of Strategy and Social and Environmental Responsibility,
School of Business Science (ESG), University of Quebec at Montreal (UQÀM),
Montreal (Quebec), Canada
e-mail: dumitriu.camelia@uqam.ca

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_3

1 Introduction

The first definition of sustainability in the scientific literature was elaborated in the 1980s. It defined the term 'sustainable development" as development that "meets the needs of current generations without compromising the ability of future generations to meet their needs and aspirations" (WCED 1987). Initially, the term referred primarily to macroeconomic issues (such as government policies regarding sustainability) and addressed mainly environmental concerns (Steurer et al. 2005). Later, the meaning of the concept was broadened to include issues related to corporate sustainability. Also, the concept gained two additional dimensions, namely social and economic dimensions. These three dimensions (economic, social and environmental) are referred to as 'the three pillars of sustainability' (Steurer et al. 2005). Thus, sustainable development "became a new research paradigm in a wide range of disciplines, from the social sciences to biology" (The World Bank 1997). Consequently, different approaches to sustainability emerged, based on the economic, ecological, and social or holistic "interpretations of sustainability" (The World Bank 1997). Accordingly, researchers have begun lately to emphasize the need for "integrating social, economic and environmental issues in all societal spheres and levels, including the corporate one" (Steurer et al. 2005).

2 Brief Review of Related Literature

To define sustainable development at the corporate level, the term 'Corporate Sustainability' (CS) emerged in the early 1990s, suggesting that companies should develop strategies that are able to make their local and short-term goals consistent with society's global and long-term goals (Costanza 1991). The set of the 'three pillars of sustainability' (Steurer et al. 2005) at the corporate level is termed the 'Triple Bottom Line' and refers to all strategic initiatives of a firm that are designed to improve its economic, social and environmental performance and to reduce the related costs of its products and processes (Dyllick and Hockerts 2002; Steurer et al. 2005). During the same period in which these two concepts (i.e., 'sustainable development' and 'corporate sustainability') emerged, another concept was introduced concurrently in social sciences, namely the 'Corporate Social Responsibility' or CSR. Initially, the concept was distinct from that of 'Corporate Sustainability' since it made reference only to social issues, but it has evolved by including the same three 'pillars' as the concept of CS (Branco and Rodrigues 2007). The problem with the 'three pillars' consists in the fact that researchers did not reach a consensus on the components of each pillar. For instance, according to Steurer et al. (2005), the social pillar of CS should focus on the relationship between the company's Board of Directors and its stakeholders, through an adequate processes of corporate governance. However, according to Dyllick and Hockerts (2002), this pillar should focus on the enhancement of social wellbeing through corporate philanthropy. Finally, in what concerns the environmental pillar of CS, the

researchers appear to agree on some components—such as pollution prevention and abatement, recycling, minimizing emissions and waste, etc. Nevertheless, numerous authors contend that "many issues remain unresolved in the field of environmental sustainability as well" (Orlitzky et al. 2011), because many definitions of sustainable development "seem conceptually deficient" and "do not clarify the managerial motives—instrumental versus non-instrumental—that should be driving environmental sustainability" (Orlitzky et al. 2011).

The Higher education institutions have an important role to play in promoting activities towards sustainable development and creating sustainable societies. According to UNESCO (2014), education for sustainability or for sustainable development (or ESD) is "a multi-disciplinary and multi-sectoral process of learning how to make decisions that consider the long-term future of the economy, ecology and equity of all communities" and building "the capacity for such futures-oriented thinking." The ESD "may embrace components from traditional disciplines such as civics, science, geography and others" (Leal Filho 2009) and has some specific characteristics (UNESCO 2006). It (a) is an interdisciplinary, holistic and values-driven learning approach, (b) builds critical thinking and problem-solving abilities and relies upon them, (c) has a "Multi-method" knowledge transmission process and relies on different pedagogies, (d) implies participatory decision-making and (e) is locally relevant.

In line with the definitions of "sustainability," Johnston et al. (2012) explain that the outcomes of a learning program on sustainability should comprise all the three 'pillars of sustainability'—economic, social and environmental—and "the ways in which they intersect." As universities across the world continuously increase their efforts to address sustainability, some organizations have begun to survey and rank them according to various sustainability-related criteria. The Aspen Institute launched "Beyond Grey Pinstripes", which ranks those MBA programs and business schools throughout the world that prepare students for "social and environmental stewardship" by "integrating the social, environmental and economic realities of business in management teaching and research." It defines four scoring categories. They are: (a) relevant coursework (20 % of the final score), (b) student's exposure (25 % of the final score), (c) business impact (30 % of the final score), and (d) faculty research (25 % of the final score).

3 Research Design and Sampling

In order to understand how North American business schools integrate the concept 'sustainable development' (SD) in their graduate business curricula, data was collected by using the PROMISE Framework developed at MIT Sloan School of Management (MIT and Jay 2014).

A purposive sample and more precisely a "paradigmatic case sample" (Palys 2008) was used. A case is paradigmatic when it is considered to be "the exemplar" for a certain class (Palys 2008). Accordingly, the initial sample (the theoretic

sample) was comprised of the 73 North American business schools (Canada and the US) that appear on The Aspen Institute's list (2013). The investigation began with the best school, according to the school rankings, and then moved to the followings schools, until the point of theoretical saturation had been reached, as this concept is defined by Glaser and Strauss (1967). The saturation point was reached after the 37th school, but the process continued with the investigation of three more schools to ensure that the saturation point had indeed been reached. Thus, the final sample, which is a "saturation sample," comprised forty North American business schools.

The graduate curriculum of each business school was scrutinized, based on data that was collected from the school's website and/or its graduate program brochures. The school's curriculum and each course description was analyzed by using the ECA method (Ethnographic Content Analysis), which is a qualitative research method that consists of a "reflexive analysis of documents" and it is particularly recommended when the research purpose consists of "narrative description and comments" (Altheide 1987). The ECA protocol is shown in Fig. 2. As the process advances, new core categories emerge and the new concepts discovered fit into existing categories. In the very beginning of the process, the pre-determined core categories were the six building blocks of the PROMISE framework (Fig. 1). However, during the process, it was decided to not limit the collection of data to the initial core categories and to not constraint the data collecting protocol according to some pre-determined core categories. Instead, it was decided to use a substantive coding process and to allow all of the new core categories and sub-categories of topics to emerge irrespective of their presence or absence in the original framework. The entire process was paper-based.

4 Results and Discussion

4.1 Research Centers and Dual Degree Programs in Sustainability

The results show that education for sustainability within the business schools in North America is, indeed, "a multi-disciplinary and multi-sectoral process" (as stated by UNESCO 2014) that is organized around specific research centers within the business school, rather than being assigned to one school department. These research units (fifty-nine in total) unite professors with various backgrounds (strategy, finance, accounting, marketing, logistics and operations, business ethics, and others) to conduct research projects and develop graduate and undergraduate programs and courses on sustainability Moreover, 55 % of the business schools that make up the sample developed at least one joint program and/or dual degree program[1] in SD, in cooperation with other schools within their university. An

[1]A credit from a single course may count toward both degrees in a joint degree program, but is applied to only one degree in a dual degree program.

Fig. 1 The "PROMISE" Framework. Adapted from the MIT Sloan School of Management 2014 (MIT and Jay 2014)

important part of the education for sustainability (EFS) is delivered by these 39 programs (Table 1).

4.2 Graduate Programs in Sustainable Development

The results concerning the "in-house"[2] graduate programs of these business schools reveal the same pattern as emerged from the academic literature reviewed, i.e., corporate social responsibility (CSR) and corporate sustainability (CSD) "have converged to very similar concepts lately" (Steurer et al. 2005). In this sense, the education in sustainable development is delivered by: (a) graduate certificates in SD/CS/CSR, (b) graduate programs (generally, MBA programs in SD/CS/CSR), (c) specific concentrations in SD/CS/CSR within the graduate programs, and

[2]Do not include the dual degree/joint programs.

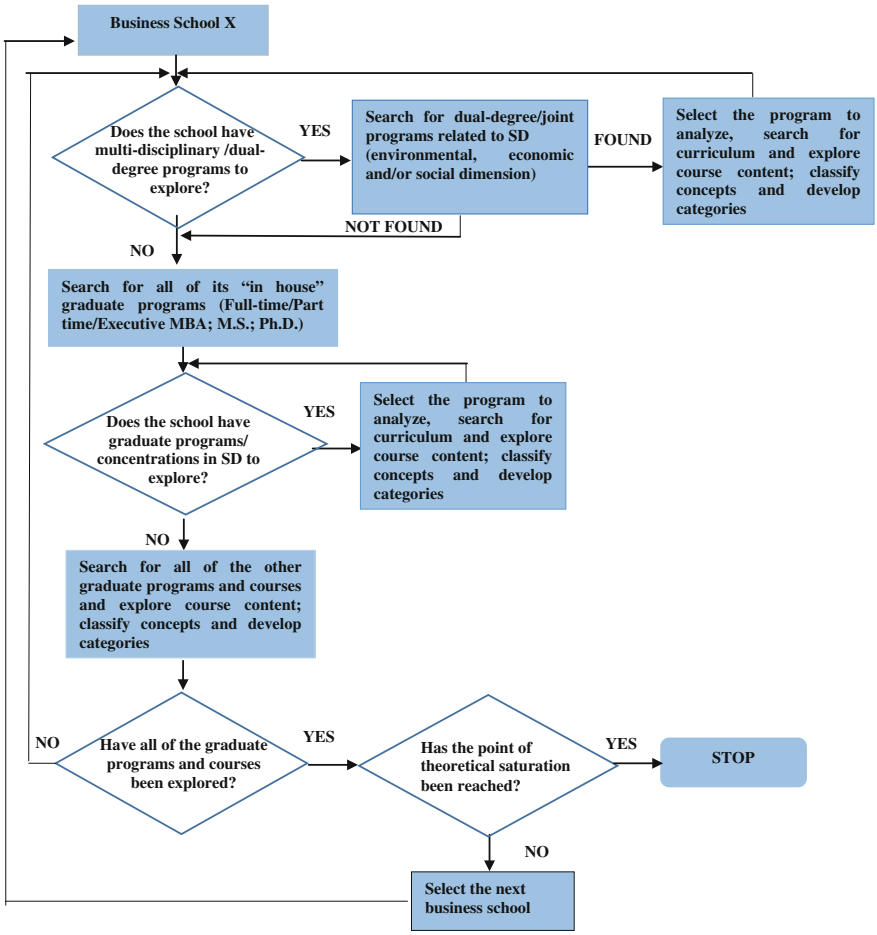


Fig. 2 The data collection protocol (Ethnographic content analysis). *Source* The author

(d) specific modules of courses, career-track and/or elective areas in SD,[3] within the graduate programs (Table 2).

Seven types of graduate programs, concentrations and/or elective areas have been identified: (a) CSR; (b) SD and CS (sustainable development/corporate sustainability/energy); (c) government and public policy; (d) nonprofit organizations; (e) business ethics, and (e) public health (Fig. 3).

[3]There is an important difference between a concentration of a graduate program and an elective area within a graduate program. In the first case, the student can obtain, if he chooses so, his MBA diploma with a concentration in sustainable development. In the second case, he or she can choose from a number of concentrations, but "sustainable development" is not among them. However, among the elective courses that he or she can choose, there is a specific group of courses (a "module" or an "elective area") on sustainable development.

Table 1 Dual degree programs and/or joint programs in sustainability

Dual degree and/or joint programs: MBA (Full-time; Part-time; Executive), M.S. and Ph.D.	Number of programs
MBA/M.S. and MBA/BS in environmental sciences (ES): M.S. "Environment and resources"; M.S. "Environmental studies"; "Environmental science"; "Environmental policy"; "Environmental and land use law"; M.S. "Technology and the environment", and others	12
Master of Public Health/MBA	9
MBA/MPA: numerous sustainability-related issues. For instance, at Stern School of Business: "Social Entrepreneurship; "Corporate Social Responsibility"; "Social Impact Investing"; "Public-Private Partnerships and Hybrid Organizations"; "Lobbying and Government Affairs"; "Complex, highly regulated industries (e.g., Healthcare and Energy)"	9
Other programs: "MBA/Master of Social Work"; "MBA/JD- Human Rights and Civil Liberties"; "MBA/M.S. in Business Ethics"; "MBA in Public Management and graduate certificate in Social Innovation"; "JD/MBA in Sustainability"	9
Total	39

Source The author

4.3 Course Offerings on the Topic of Sustainability

The results show that there are 1047 courses that solely or partially focus on sustainability and related topics,[4] with an average of 26.175 courses per school. However, these courses are taught mainly in sustainability-focused programs (dual-degree programs and MBA programs in SD, CS, CSR, environmental sustainability, business ethics, and the like) or grouped together to form a 'concentration' or an 'elective area' in sustainable development within some of the graduate programs of these schools. Typically, a business school in the sample has numerous MBA and/or M.S. programs and a Ph.D. program, all of which have many concentrations (such as "Accounting", "Finance," "Strategy," etc.). However, unless students choose to enroll in a graduate program that is sustainability-focused, they will usually be exposed to only one core course in SD. This will be a course in Business Ethics. In some of these schools, the students who are not enrolled in a sustainability-focused program have access to some courses in SD that are grouped into 'modules' or 'elective areas' and are offered as electives across multiple programs. However, almost all of the other graduate courses that are taught in programs that are not sustainability-focused do not integrate sustainability-related issues in their contents. This conclusion is not meant to be a criticism of the approach that North American business schools have adopted to teach sustainability. One must acknowledge that a student who is enrolled in a business school and is not heavily exposed, during his graduate education to all of the main

[4]These courses will be referred by the terms "courses on SD" or "sustainability-focused and sustainability-related courses.

Table 2 The graduate programs in sustainable development that North-American business schools offer ("in-house")

Type of programs	Categories	Percentage (%)
Graduate programs (MBA/M.S./Ph.D.) sustainability-focused	• Social responsibility/CSR/social related issues: 6 • Sustainability/CS/Energy and sustainable development: 4 • Nonprofit organizations: 2 • Public health and related issues: 4 • Business ethics: 5	21.21
Graduate certificate programs (sustainability-focused)	• Corporate Social Responsibility (CSR), social innovation, social ventures and funding: 7 • Sustainable development/CS: 8 • Nonprofit organizations: 2 • Business ethics: 2	19.2
Concentrations sustainability-focused within the graduate programs (MBA/M.S./Ph. D.)	• Corporate Social Responsibility (CSR): 4 • Sustainable development/CS: 8 • Business ethics: 2 • Public health:7 • Nonprofit organizations: 2 • Government affairs and public policy: 3	26.26
Specific modules of courses, career-tracks and/or elective areas within the graduate programs	• Corporate Social Responsibility (CSR): 11 • Sustainable development/CS:13 • Public health: 2 • Business ethics: 4 • Government affairs and public policy: 2 • Corporate governance and compliance:1	33.33

The number of graduate programs, concentrations and elective areas that are sustainability-focused: 99

disciplines of business (e.g., Finance, Strategy, Marketing, Accounting, etc.) but is heavily exposed only to courses on sustainability will be unable to make a significant contribution (theoretical or practical) to sustainability. However, this approach of teaching sustainability makes it difficult for an external investigator to assess 'the impact,' (i.e., the percentage of the enrolled students who are exposed to knowledge about SD).

The classification of these 1047 courses according to the PROMISE Framework appears in Table 3.

The PROMISE framework does not include a community-related dimension of SD. However, 5.83 % of the 1047 courses focus on topics that are related to community development (sustainable cities; neighborhood conservation and change; community, planning, and ethics; smart growth and sustainable community; green

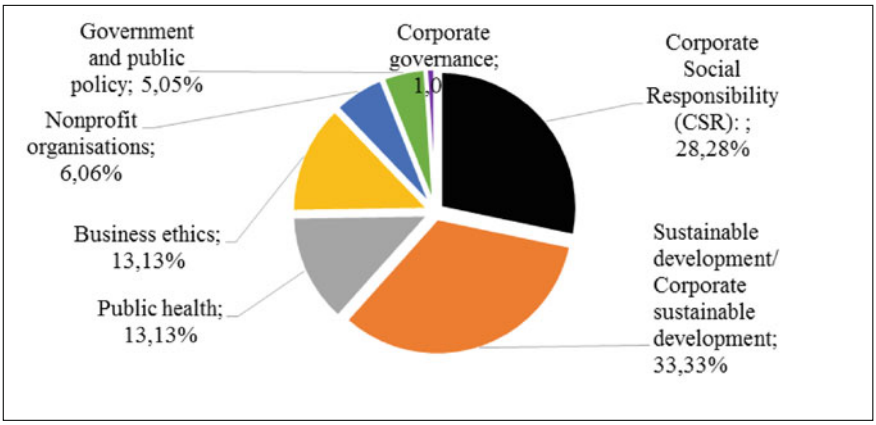


Fig. 3 Categories of graduate programs, concentrations and elective areas in SD/CSR and related topics (percentage of the 99 initiatives in SD). *Source* The author

buildings; sustainable development in cities and regions; and clean water in green cities, etc.). These issues were included in a new dimension that was named "community-related dimension."

About 48 % of the 1047 courses were classified into the "Organization–driven dimension" of the PROMISE Framework. They were further grouped into three categories. The first category, "Corporate Social Responsibility", comprises the courses with the following topics: (a) social enterprise and social impact; (b) social innovation and microfinance, and; (c) the "Bottom of the Pyramid" (BOP) strategy of the multinational corporations. The main topics of the courses included in the second category, "Corporate Sustainability", are: (a) sustainable development (introductory concepts); (b) corporate sustainability; (c) sustainable accounting and fraud examination; (d) corporate governance; (d) Enterprise Risk Management or ERM, and; (e) the sustainability of each of the enterprise's management functions (marketing; operations; supply chain management and human resources). Finally, the third category of courses are those on business ethics. The results show that about 10 % of the 1047 courses and about 25 % of those included in this specific category ("organizational dimension") are courses on Business Ethics. Their important weight in the curricula is the result of various factors, including the presence of numerous research centers on business ethics in these schools (about 17 % of all of the SD research centers).

The results show that the topics related to the market-driven dimension are rather poorly represented in the course offerings of these schools. Even though about 6 % of the sustainability-related courses appear to deal with market-driven issues (see Table 3), most of them deal mainly with complex, regulated industries and markets such as mining and pharmaceutical industries, and adopt a holistic approach. There are a few graduate courses that focus on derivatives on energy, financial instruments meant to provide incentives for companies to reduce their greenhouse gas emission,

Table 3 The distribution of the 1047 courses, according to the "PROMISE" Framework

The distribution of the 1047 courses, according to the "PROMISE" framework	Percentage (%)
1. The social dimension	16.29
S/Food	2.01
S/Poverty and social inequality	2.20
S./Democracy, advocacy, social movements,	1.34
S./Philanthropy and fundraising	1.43
S/Social justice, human rights, etc.	2.34
S/Public health	6.97
2. The Environmental Dimension	20.38
E/Environmental science—general	4.97
E/Ecology and environmental sustainability	1.43
E/Resource economics (general)	0.97
E/Water Man	0.97
E/Oil and Gas Man	1.05
E/Energy and energy efficiency	4.78
E/Clean Tech Space	1.62
E/Climate change	1.34
E/Carbon, pollution and transportation	1.15
E/Restauration, conservation	1.43
E/GIS and others	0.67
3.The organization–driven dimension	47.38
ORG/Corporate social responsibility (CSR)	15.57
ORG/Corporate sustainability (CS)	22.16
ORG/Business ethics	9.65
4. The institutional dimension public policy attempting to alleviate societal and environment related problems	3.53
5. The market-driven dimension environmental accreditations and green labels; social investing funds, sustainability indices and others	6.02
6. The Community-related dimension sustainable communities; smart cities, shared—use mobility, sustainable architecture and building design; smart public networks, disadvantaged neighbourhoods	5.83
7.The individual dimension	0.57
Total (1–7)	100.00

Source The author

voluntary methods of environmental performance certification, and regulated futures exchanges that are sustainability-related.

Finally, the business curricula of these schools contain a large number of graduate courses on leadership, but only 0.57 % of them focus on topics that are related to the individual dimension of the PROMISE Framework.

The results of this study show that the knowledge of SD is transmitted and acquired by means of: (a) theoretic courses, (b) case study analyses, (c) guest

speakers for some course sessions, (d) sustainability consulting projects (SCP) and "practicum courses," (e) company-sponsored projects (CSP), (f) "Community Business Projects (CBP)" and (g) "Sustainable Enterprise Speaker Series." A "Community Business Projects (CBP)" is usually an activity for which students receive academic credit. In some of each schools, they are asked to solve a business problem for a local not-for-profit organization, to design a business development plan for their city or a marketing strategy for a social enterprise. With regard to sustainability consulting projects (SCP) and company-sponsored projects, these are projects for which students serve as consultants, working in multidisciplinary teams on company-sponsored projects to solve real problems faced by various companies in designing their sustainable strategies. Also, these schools adopted some initiatives called "Speaker Series." These take the form of public sessions or graduate courses for which students receive academic credit.

5 Conclusions and Theoretical Implications

- The PROMISE Framework developed at MIT (Fig. 1), which was used in this study, has proved to be a very comprehensive tool that was able to collect, sort and classify, according to its six dimensions, 94.17 % of the data. However, a new core category emerged during the ECA process and it comprises 5.83 % of the concepts that could not be classified according to the six dimensions of the PROMISE Framework. These results suggest that a new dimension of sustainability is about to emerge. It has been named "the community-related dimension" and includes issues related to (a) sustainable communities, (b) sustainable/smart cities, (c) shared—use mobility, (d) sustainable architecture, (d) sustainable building design, (e) smart public networks, (f) disadvantaged neighbourhoods, and the like.
- The market-driven dimension of the PROMISE framework needs more attention from the business schools worldwide, who should mobilize more resources to contribute to the advancement of knowledge on these topics (such as environmental accreditations and green labels; social investing funds, sustainability indices and others). Presently, only 6.02 % of the 1047 courses that are sustainability-focused deal with topics that are related to the market-driven dimension of the PROMISE Framework.
- The results of this study are in line with those obtained by many researchers who contend that sustainability has three pillars (economic, environmental and social pillars). In their research and teaching activities, the business schools in this study appear to be very comfortable with the economic and social pillars, especially at the organizational level. To be competitive in teaching and research on the 'environmental pillar', they should further collaborate with other schools, especially with the schools of environmental sciences and those of engineering, by designing dual degree programs.

- The business schools should improve their offerings of sustainability-focused courses in their Ph.D. programs. Ninety four percent of all of the sustainability-related initiatives of these schools are for Master's or MBA students, and only six percent of them are for Ph.D. students. Let's remind that there is a strong relationship between the number of Ph.D. students in a specific discipline and the research intensity in that discipline (at the university/national/global levels).
- The results confirm that the EFS approaches that are discussed in Leal Filho (2009) and UNESCO (2006, 2014) are comprehensive and representative. The EFS process that was put in place by the North American business schools is, indeed, an interdisciplinary, holistic learning approach. Thirty four of the forty schools that make up the sample have at least one research institute, center or "initiative" on sustainable development and related topics (social responsibility; corporate sustainability; business ethics, and; public policy). These research units (fifty-nine in total) unite professors with various backgrounds (strategy, finance, accounting, marketing, logistics and operations, business ethics, and others) to conduct research projects and develop graduate and undergraduate programs and courses on sustainability. Fifty-five percent of these business schools have developed at least one joint program and/or dual degree program in SD and related topics. Moreover, the knowledge transmission process is a "Multi-method" one and rely on different pedagogies as it was suggested by UNESCO (2006). The information about SD is transmitted and acquired through: (a) theoretic courses, (b) case study analyses, (c) guest speakers for some course sessions, (d) sustainability projects (consulting projects, company-sponsored projects and community—based projects), and (d) "Sustainable Enterprise Speaker Series."
- Finally, the results suggest that such an initiative should be locally relevant, and address local as well as global issues as it was suggested by UNESCO (2006). Indeed, many American business schools have developed graduate programs in public health, but very few Canadian business schools have done so. This difference can be explained by the particularities of the health system in each of these two countries. In this regard, the American business schools have more critical issues to address in their teaching and research activities than do their Canadian counterparts. Also, some Canadian business schools that are located in Western Canada and some American business schools that are located in Texas have developed graduate programs that focus on energy markets with the aim of responding to various needs (such as qualified human resources, innovative strategies, new technologies, etc.) of specific clusters[5] in these regions that operate in the energy market.
- Like any other research, this research has its limitations. With regards to the generalizability and transferability of results, one can say that most of the results are transferable to other contexts or settings, although others need to be adapted.

[5]Porter (1998) defines clusters as being "geographic concentrations of interconnected companies and institutions in a specific field.".

For example, the percentages in Table 3 will be different for a school of engineering. However, if such a school want to develop graduate programs in sustainability, it will need to include some topics in business, and Table 3 will provide a good starting point for such an initiative. Also, it is important to note that all of these schools are located in Canada and the United States. The specific institutional and cultural characteristics in North American countries should be considered by researchers who want to apply these results in different political, institutional and cultural contexts.

References

Altheide, D. L. (1987). Ethnographic content analysis. *Qualitative Sociology, 10*, 65–77.

(The) Aspen Institute-Center for Business Education. (2013). *Beyond grey pinstripes 2011–2012. TOP 100 MBA programs.* Washington, DC: The Aspen Institute. Available http://www.aspeninstitute.org/publications/beyond-grey-pinstripes-2011-2012-top-100-mba-programs. Accessed October 15, 2015.

Branco, M. C., & Rodrigues, L. (2007). Positioning stakeholder theory within the debate on corporate social responsibility. *Electronic Journal of Business Ethics and Organization Studies, 12*(1), 5–15.

Costanza, R. (1991). *Ecological economics: The science and management of sustainability*. New York: Columbia University Press.

Dyllick, T., & Hockerts, K. (2002). Beyond the business case for corporate sustainability. *Business Strategy and the Environment, 11*(1), 130–141.

Glaser, B., & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research*. New York: Aldine Publishing Co.

Johnston, L., Collins, B. L., Boyle, A., & Womack, H. D. (2012). Research and solutions. Looking at sustainability through a different LENS. *Sustainability*, *5*(4), 244–247.

Leal Filho, W. (2009). Dealing with misconceptions on the concept of sustainability. *International Journal of Sustainability in Higher Education, 1*(1), 9–19.

MIT, & Jay, J. (2014). *PROMISE: A systems approach to sustainability strategy* (PowerPoint slides by Jason Jay, webinar. February, 2015). https://s3.amazonaws.com/sbweb/slideshow/SB+webinar+SSB+exec+ed+preview.pdf. Accessed October 01, 2015.

Orlitzky, M., Siegel, D., & Waldman, D. A. (2011). Strategic corporate social responsibility and environmental sustainability. *Business and Society, 50*(1), 6–27.

Palys, T. (2008). Purposive sampling. In L. M. Given (Ed.), *The Sage Encyclopedia of qualitative research methods* (Vol. 2, pp. 697–698). Los Angeles: Sage.

Steurer, R., Langer, M. E., Konrad, A., & Martinuzzi, A. (2005). Corporations, stakeholders and sustainable development: A theoretical exploration of business-society relations. *Journal of Business Ethics, 61*, 263–281.

UNESCO. (2006). *UNESCO framework for the UN DESD—International implementation*. Paris: UNESCO. http://unesdoc.unesco.org/images/0014/001486/148650E.pdf. Accessed October 01, 2015.

UNESCO. (2014). *Education and the search for a sustainable future—Policy dialogue (ED-2009/WS/7)*. Paris: UNESCO. http://unesdoc.unesco.org/images/0017/001791/179121e.pdf. Accessed October 01, 2015.

World Commission on Environment and Development (W.C.E.D). (1987). *Our common future*. Oxford: Oxford University Press.

(The) World Bank. (1997). *Sustainability assessment: A review of values, concepts, and methodological approaches. Research report for the World Bank*. Washington, DC: The World Bank.

Author Biography

Camelia Dumitriu holds a Doctoral degree in Management, a Master of Science degree in electrical engineering and telecommunications, and; an EMBA Certificate in strategy and decision making theory. She is professor at University of Quebec at Montreal (UQAM, Canada) and teaches corporate strategy and risk and crisis management. Her research interests include corporate governance and strategic planning, including restructuring and governance systems in universities in Canada and the United States; enterprise risk management (ERM)/risks mapping for multinational corporations; regulated industries, and; disaster preparedness. She has published over 70 scientific articles and conference papers, and eight books and book chapters (in French/English/Romanian). She received numerous international teaching and research awards such as the Canadian International Development Agency's (CIDA) fellowship award, the first prize in the European CEEMAN Case Writing Competition, numerous research grants in business and finance (the World Bank, SSRHC/Government of Canada, Tempus grants, etc.). She also has served as a consultant for policy makers and more than 40 organizations around the world, on issues related to her expertise.

The Role of Non-academic Staff in Designing the Green University Campus

Eglė Katiliūtė, Živilė Stankevičiūtė and Asta Daunorienė

Abstract

A designing of a green university campus in a sustainable university requires a deep involvement of all stakeholders, including non-academic staff. Non-academic staff has an authority and power to make decisions for and against sustainability initiatives, hereby its role is of high importance, especially when universities act in a market economy. The paper analyses the case of a university and describes how non-academic staff perceives its role in designing of the campus based on a sustainable university approach. A special focus is given to various aspects: from integration of sustainability into university's strategy and infrastructure processes to non-academic staff perception and initiatives for designing of the green campus. Analysis of the interviews with non-academic staff helps to identify problems and raise possible solutions for green campus development. Finally, some proposals which may be undertaken by universities in order to advance towards becoming more sustainable are outlined.

Keywords

Sustainable university · Green university campus · Greening campus barriers · Non-academic staff

E. Katiliūtė (✉) · Ž. Stankevičiūtė · A. Daunorienė
School of Economics and Business, Kaunas University of Technology,
K. Donelaičio St. 73, 44029 Kaunas, Lithuania
e-mail: egle.katiliute@ktu.lt

Ž. Stankevičiūtė
e-mail: zivile.stankeviciute@ktu.lt

A. Daunorienė
e-mail: asta.daunoriene@ktu.lt

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_4

1 Introduction

Given the ascribed role of Universities in a society and prevailing environmental and sustainability challenges, Universities are coming under increasing pressure to engage with and respond to climate change and other sustainable development issues and associated risks and opportunities. Because of their particularity the universities play a crucial role to a sustainable future, they are major catalysts towards 'sustainable societal patterns' (Lozano et al. 2013). They are expected to be the engines and innovation centres for sustainable development through teaching and learning, research and knowledge transfer (Osmond et al. 2013). As regards teaching, universities are educating "future leaders" (Cortese 2003; Geng et al. 2013; Lozano 2006), who will make decisions against or for sustainability on political and organizational level. Through research activities universities can become sustainability innovators (Wright and Wilton 2012) focusing on solving the issues related to people's desire to improve their life and the limitations imposed by the nature. Thereby, universities have a responsibility to society concerning the issue of sustainability (Lauder et al. 2015; Boyle 2004).

More and more universities commit themselves to sustainability: some declarations have been signed (Yuan et al. 2013; Arroyo 2015); some assessment and reporting tools were proposed for identifying best practices, spreading experience and measuring progress towards sustainable university (Arroyo 2015). However, in spite of proposed guidelines, sustainable development could still be considered to be a radical innovative idea in the universities (Lozano 2006). Trying to overcome a complicated meaning of sustainable development, some universities choose a "step-by-step" strategy and start from an environmental sustainability dimension. For many universities campus "greening" is often the first step towards sustainability (Townsend and Barrett 2015; Müller-Christ et al. 2014). To meet this challenge university needs to have a participatory approach, to involve all university stakeholders groups. The role of university's non-academic staff becomes more influential, especially in designing of campus, as universities operate in new managerial culture and free market economy. Accordingly, this paper analyses the case of a university and describes how non-academic staff perceives its role in designing the campus based on a sustainable university approach.

2 Theoretical Framework

2.1 Green University Campus

The complexity of sustainable aspects implies that universities choose the environment aspect as the most predominant to demonstrate the commitment to sustainable development (Wright 2010; Wright and Horst 2013). Fonseca et al. (2011) also argue that a key sustainable development issue is an environmental focus.

Table 1 Dimensions of green campus initiatives

Authors	Dimensions
Alshuwaikhat and Abubakar (2008)	Green buildings; green transportation; campus preservation
Vaughter et al. (2016)	Waste; energy; transportation; building design, biodiversity, water use and food services
Tan et al. (2014)	Hardware perspective (infrastructure construction and operation); soft perspective (green humanity)
Faghihi et al. (2015)	Demand side approach (people's behaviour modification); supply side approach (the use of efficient technologies)

Conceptualizing universities as 'small cities' reveals their impact on the environment. According to Bernheim and Garrett (2003) universities are an integral part of the automobile-intensive, high-consumption, waste-intensive global landscape. In terms of waste generation, water and electricity consumption and heating, universities can be compared to complex buildings like hospitals and mega hotels (Alshuwaikhat and Abubakar 2008).

Different authors underline various dimensions of green campus initiatives (Table 1).

As it can be seen in Table 1, the initiatives reflect approaches the organizations could follow. According to Tan et al. (2014), from the perspective of hardware, campus "greening" is related to energy conservation and carbon reduction in the operation of campus infrastructure, while from the perspective of software, it encompasses development and spread of green humanity and talent cultivation regarding sustainability.

Faghihi et al. (2015) highlight demand side and supply side approaches and two campus "greening" initiatives: energy efficiency and energy conservation. A demand side approach is related to people's behaviour modification, whereas a supply side approach deals with the use of efficient technologies.

2.2 Responsibilities for Green Campus

One thing is to implement campus "greening" initiatives through a set of operational and/or management solutions and another thing is to take a responsibility towards supporting of implemented and implementing of new initiatives. There are generally two approaches to incorporate green campus initiatives within universities: top-down and bottom-up (Beringer 2007; Yuan et al. 2013). According to Brinkhurst et al. (2011), there are many top down initiatives which were successful in planning, policy making, and regular assessment of sustainability, as they were supported by the resources provided by the administrators. The authors note that university administrations are powerful agents initiating a change in the university. In the context of sustainability policies, majority of institutions agree that responsibility for sustainability should take an institution as

a whole (Vaughter et al. 2016). However the difference between the decision-making structures of higher education institutions and other enterprises leads to a unique set of roles and responsibilities (Clarke and Kouri 2009). Success of campus "greening" initiatives depends on leaders, who can propose a solution horizontally and vertically and link responsibilities between different faculties, departments, functions and administrative sections (Egri and Herman 2000; Neumann and Neumann 2000; Lee and Schaltegger 2014; Disterheft et al. 2012). Bottom-up approach in green campus development includes coordination and innovation of every department operations and management in university campus area, requires the joint participation of teachers and students, and, if necessary, raising of awareness.

2.3 "Greening" Campus Barriers

The literature focuses mainly on the barriers behind the introduction of sustainability initiatives (Alshuwaikhat and Abubakar 2008), incorporating of environmental management issues (Jabbour et al. 2013) or generally coping with changes (Lozano 2006), however the same barriers are of high importance for university campus "greening" (Table 2).

As it can be seen in Table 2, moving to top-down and bottom-up barriers, a distinction can be drawn between institution's role and personal attitudes. Generally, institution's role is one of the most important sides expected to influence the integration of green initiatives. Brinkhurst et al. (2011) also found that ineffective initiative's design influences a factor for setting up of campus sustainability practices. Similarly ineffective initiative's design related to the lack of institutional knowledge and skills of navigating bureaucracy comes up from the bottom-up side of view.

Table 2 "Greening" campus barriers

Authors	Barriers
Arroyo (2015)	Lack of leadership; budgetary constraints; deficient organizational structure; inertia and resistance
Brinkhurst et al. (2011)	Top-down (institution barriers—the lack of institutional knowledge and skills); bottom-up barriers (personal attitudes)
Verhulst and Lambrechts (2015)	Barriers related to the lack of awareness Barriers related to the structure of higher education Barriers related to the lack of resources
Evangelinos et al. (2009)	The provision of information and acquirement of knowledge The level of participation and cooperation from the members of a community The existence of limitations due to the organizational structure of the university Financial constraints

Moreover, some researchers (Cansino et al. 2011; González et al. 2012; Egging 2013; Soares et al. 2015) emphasized the need to address attention to technological, market organization, information and behavioural barriers.

2.4 Overcoming "Greening" Campus Barriers

The reduction of energy consumption in buildings depends on users' habit, that's why universities should raise the environmental awareness within campus communities (Dahle and Neumayer 2001) or even involve staff in decision making (Brinkhurst et al. 2011). Alshuwaikhat and Abubakar (2008) state that in order to ensure a more sustainable campus, universities should implement university Environmental Management System, to stimulate participation, and to promote sustainability in teaching and research activities. As stated by Horhota et al. (2014), in order to deal with the lack of engagement, university has to communicate the importance of sustainability better. These authors also pointed out that financial concern barriers could be minimized by the creation of some funds. Barata et al. (2011) offer for university campus to establish a laboratory to test and implement new strategies leading to reductions in infrastructure costs and less negative impacts on the surrounding areas. Also a university needs to develop a set of indicators to measure a progress of campus "greening" operations.

3 Methodology

To select appropriate information for this research, a qualitative research strategy, the case study design (Eisenhardt and Graebner 2007) within interview method was completed. The research was carried out during October–November 2015. Data were collected through in-depth, in-person interviews conducted at the University, Lithuania (hereinafter LitUniversity). The interview sample constituted of 6 non-academic staff representatives chosen by criteria of whether they would have the knowledge necessary to be able to answer the questions. The interviewees were therefore non-academic staff who dealt with environmental and operational activities on a daily basis, such as heads of administrative departments, IT managers, property managers, services managers. All non-academic staff representatives were professionals working in the LitUniversity administration for more than 5 years. Their age ranged from 39 to 49 years old.

Each interview lasted 30 min on the average (ranging from 18 to 45 min) and all of them were recorded and transcribed. Qualitative data were analysed by coding and categorising the responses into major conceptual areas.

Four main themes were covered during the interview: (1) the concept of green and sustainable university and meaning of being green, (2) green campus initiatives, (3) roles and responsibility, (4) barriers and how to overcome it.

4 Results

4.1 The Concepts of Green and Sustainable University and the Meaning of Being Green

The interview results reveal that non-academic staff links the concept of green University with the environmental approach; investments to green initiatives; green procurement and healthy work environment.

Concerning the environmental approach, the ecology was highlighted: "*green university follows work principles of ecology, keeps certain values. For me green means ecological*" (R1). Making no difference between high education and any other single sector of society, the same attitude was shared by another member of non-academic staff: "*for green university or enterprise all these green things related with ecology are important*" (R3). Another aspect of environmental approach was expressed through resource saving and waste management. Some non-academic staff perceived green university as a university, which "*conserves natural resources first*" (R6) or "*reduces amount of waste*" (R5), hereby green university is "*conserving, rational and aimed at more efficient activities*" (R4).

Regarding investments to green initiatives, the respondents considered university as a green if university institutionalizes a commitment to "greening" by "*putting directions and investment row in the strategy*" (R3). Investments were conceptualized in the form of financial resources, whereas: "*green things are related to <...> investments, which save energy costs*" (R3) and in the form of human resources, because green university "*devotes administrative resources*" (R1).

Green university pursues green procurement and "*buys recycling paper, energy-saving light bulbs and assesses other possibilities*" (R5). One more association of green university was related to a healthy environment through minimizing the negative impact of university activities on human health, whereas green university: "*pays attention to safe work environment*" (R6).

Non-academic staff provided a clear and different understanding between a green and sustainable university. Sustainable university is "*responsible to future generations, to its community and society*" (R6), whereas green university: "*is the part of sustainable university*" (R1).

As regards the meaning of being green, there was no uniformity among respondents in their answers. Following the normative approach, one interviewee spoke of moral side and indicated three aspects why it is relevant for university to be green: "*in the name of earth. In the name of reducing the use of resources. In the name of reducing the consumption without limits*" (R5). Another respondent followed a "social contract" approach, treated a university as having a specific mission and responsibility to society with regard to sustainability: "*The University itself, as an institution, in accordance with its mission, has to be enlightened, as a start-up in the whole of our community, to show good example*" (R6). According to the pragmatic approach, the meaning of being green was maintained by attitudes, that

"*In carrying out green initiatives, the University saves its resources, improves the environment and the impact of the environment on human*" (R5) or "*Being green is important for infrastructure, it allows conserving the environment and resources*" (R4).

Non-academic staff highlighted that being green is important to external stakeholders. Acknowledging that "*being green is one of the attractiveness features of university*" (R6), the university uses communication strategies in order to "*inform the society what we are actually*" (R2). It seems that the non-academic staff sees the "green" "*label as a marketing tool"*, because "*for us it is important that* "*green*" *plays in the market*" (R2). Some respondents also mentioned internal stakeholders as beneficiaries. This included some thoughts that being green is relevant "*for people who work at university*" (R6). The link between being green and staff motivation was revealed alike: "*working in green university serves as motivation for employees*" (R2).

4.2 Green Campus Practices (Initiatives)

Participants of this research revealed wide range of green campus practices. Mainly these practices are reflected on energy efficiency, energy conservation and solid waste management.

The university applies a supply side approach by using "*recycled paper, energy-saving light bulbs*" (R5) or "*recycling waste*" (R1). However, a demand side approach was revealed by some non-popular decisions made by non-academic staff in order to change the community's behaviour. As an example—reduced parking places in campus, delivered sustainable mobility plan, installed more covered places for parking of bicycles.

Non-academic staff perceives that university "greening" is a continuing process: "*Greenness does not appear in a day or a year, this is a long-term process, which should be proved with evidences*" (R3).

4.3 Roles and Responsibilities of Non-academic Staff

Everybody agreed that the main responsibility of university campus "greening" belongs to a top-level management: "*The primary responsibility lies with the top level management who draws the strategy*" (R3). Non-academic staff underlines the need for institutionalizing of green activities within university campuses as strategy provides clear directions for the way the university can promote and achieve sustainability.

However, the participants of this research pointed out the importance of sharing responsibility as well. The demand of involvement of more stakeholders was stressed as follows: *"every employer should be responsible*" (R2) and "*an employer and student have to feel responsibility*" (R2). Further, the respondents mentioned the specific responsibility of mid-level managers: "*mid-level managers should be*

responsible not only in the administrative structure, but over all units as well. We speak about horizontal level". (R2). One of the respondents stressed out the contemporary coordination role of green campus projects: "*it could be a green project's tutor—the one who awakes people when they sleep and gives them the incentive to act*" (R5).

Non-academic staff spoke about a voluntary responsibility, which is not related to orders and punishments: "*Responsibility should come from internal needs and motivations, instead of the instructions*" (R2). The commitment of all community was also highlighted: "*one person will do nothing if it ever strikes the wall*" (R5). Another aspect was related with being an example for followers, as many of non-academic staff underlined personal contribution to green campus activities. According to one of the respondents, the position obliges: "*Rector, vice-rectors have to become green, to become agents of idea*" (R1). Another participant highlighted that "*mid-level managers need to perceive the standpoints by themselves*" (R4). Hereby, two approaches (top-down and bottom-up) to incorporate green practices within university were identified: "*it should be on two levels—coming from the head to the bottom, and staff awareness must reach the manager—from bottom to top*" (R6).

Each representative of non-academic department showed some practice to the contribution of university campus greening. As an example they provided following aspects: "*We are responsible for all university implementing projects which should match the sustainability principles*" (R6) and "*We clarify by communicating the availability of procurement initiator to buy green products*" (R5). However, these examples reflect fragmented and functional role of non-academic staff; it lacks of holistic and systemic approach to campus greening.

4.4 Barriers

The lack of financial resources is the red line issue at the university. In the light of the complex finance management, university meets a twofold challenge. First, the budget is limited and the implementation of majority of activities needs some financial support: "*we feel the lack of financial resources. Today university has a million places, where to spend money*" (R4). Secondly, the market determines the price difference: *"the price of ecological goods is much higher than of non-ecological ones*" (R6). Such difference limits the possibility for the university to implement green activities: "*we could order green cleaning services, but the price for green cleaning is plus 30 %*" (R1).

Due to the relatively long lifespan of university campus infrastructure, non—academic staff mentioned another barrier related to campus old infrastructure: "*you will not become green especially when you have old buildings*". (R4)

As regards to conservationism or unwillingness to change, the self-consciousness and people's way of thinking play a crucial role. According to one respondent: "*green is the attribute of an individual*" (R1), another respondent stresses employee's way of thinking: "*it is not mine, it belongs to the state*" (R4).

Following this attitude means, that: "*electricity can be burned all night long, all of the computers can be switched on, you can print as much as you want*" (R4).

Non-academic staff emphasized the lack of relevant and complete information concerning to the meaning and the importance of green campus activities: "*maybe the top-level management understand, but these things are not communicated down*" (R2). This situation reveals some weakness of internal communication, when strategic decisions are not delivered top-down.

The lack of awareness is one more barrier for green campus. Education is very important—the university has a mission to provide knowledge not only to students, but to employees as well. Education influences the attitude of staff and leads to: "*the changing habits*" (R1).

4.5 How to Overcome the Barriers

Non-academic staff identified some directions in order to overcome the barriers for green campus—mostly mentioned directions are internal communication, staff education, employees' consciousness and budget for green campus activities. One of the respondents has agreed that "*only through human interaction and their awareness, sharing their ideas we can learn about green ideas*" (R5). According to another participant *"the consciousness of people and communication provided by administration"* (R6) could rise the popularity of green activities. The third respondent stressed that: *"the activity plan, appointed employees and budget for implementation of activity plan"* (R2) are the main means for overcoming the campus "greening" barriers. These results reveal that barriers reflect tools to overcome barriers and vice versa. This situation is really challenging for the university, especially for policy makers and its implementers.

5 Discussion

According to Lozano (2006), some universities confuse a sustainable development with the environmental aspects. This insight is consistent with Wright and Wilton (2012) findings—some respondents relate sustainable university just to the environmental sustainability. The results of the research done by the paper authors do not support the previously mentioned findings: non-academic staff of LitUniversity clearly perceives a difference between a sustainable and green university. Non-academic staff emphasizes green label not only as an image format, but also as a tool for employees' welfare creation.

The practices identified during the research are in line with the practices identified in the scientific literature, for example: long-standing comprehensive campus plan (Koester et al. 2006); energy saving and solid waste management (Geng et al. 2013). Nevertheless, non-academic staff is brave to implement unpopular decisions, for example, to decrease the number of parking places.

The research results support the statement that the lack of designated responsibility for sustainable actions is common issue among universities (Horhota et al. 2014; Wright and Wilton 2012). In other words, non-academic staff feels not responsible for coordinating changes and argues that the power lies elsewhere else (rector, vice-rector, students).

Financial barrier being the most often mentioned by the research respondents is consistent with the findings of Wright and Wilton (2012) and Wright (2010). This allows stating that limited available funding restricts green campus initiatives. Moreover, non-academic staff of LitUniversity treats the prices deference between eco-friendly products and services as one of the irrationality striving for sustainability. That corresponds to Horhota et al. (2014) research, as staff members consider the cost of eco-friendly products to be a major barrier to using them.

The research also reveals the lack of relevant and complete information. This barrier is in line with the insight that management personnel tend to have little communication across stakeholders within their institution (Clarke and Kouri 2009). As the attitude influences actions, Wright and Wilton (2012) emphasize the difficulties arising when facing people with different views. The research findings provide the lack of common understanding and this also represents barrier for "greening" campus.

The research findings support the notion that overcoming the barriers is complex process due to its duality: hardware and software changes could be implemented (Horhota et al. 2014). In order to explain how universities could overcome free market barriers further studies are needed.

6 Conclusions

The research results reveal that non-academic staff makes difference between green and sustainable university concepts emphasizing that greening is only the first step to sustainability. Non-academic staff emphasizes the added value of being green; moreover they can prove and justify the campus "greening" importance to internal and external stakeholders.

The dominant perspectives of greening campus initiatives are related to hardware and supply side approaches. That could be confirmed by the following green campus practises: waste sorting system, energy efficiency and energy saving programmes, sustainable mobility plan. However, the activities encouraging entrepreneurial creativity or demonstrating that "greening" campus can produce a tangible return on investment are missed.

In terms of non-academic staff role, the fragmented functional understanding was identified. Moreover, common understanding and shared responsibilities are missed. The main responsibilities are devoted to the top management or to the community as a whole; not accepting that non-academic staff has to have coordinating role in designing the green university campus. This could be explained that

non-academic staff lacks the environmental management awareness and treats it as a secondary issue.

The study results reveal that non-academic staff explores barriers to campus "greening" based on their personal experience. The barriers identified by respondents mainly represent two different approaches of campus greening barriers. The demand side approach barriers are the lack of relevant and complete information and the lack of awareness. The supply side approach presents the lack of financial resources and old campus infrastructure. Although addressing barriers to campus "greening" requires creative actions, non-academic staff, unfortunately, proposed only general means, such as sharing the ideas. This implies that non-academic staff has vague perception of their role in how to embed green humanity and strengthen the staff commitment towards designing the green campus as an institutional priority. Aiming to move from discrete successful projects towards the systematic transformation of university campus greening it is necessary not only to institutionalize best practises to strategical documents but also to ensure the behavioural change of non-academic staff in their day-to-day activities.

References

Alshuwaikhat, H. M., & Abubakar, I. (2008). An integrated approach to achieving campus sustainability: Assessment of the current campus environmental management practices. *Journal of Cleaner Production, 16*(16), 1777–1785.

Arroyo, P. (2015). A new taxonomy for examining the multi-role of campus sustainability assessments in organizational change. *Journal of Cleaner Production*, *xxx*, 1–12. doi:10.1016/j.jclepro.2015.08.100

Barata, E., Cruz, L., & Ferreira, J. (2011). Parking at the UC campus: Problems and solutions. *Cities, 28*(5), 406–413.

Beringer, A. (2007). The Lüneburg sustainable university project in international comparison: An assessment against North American peers. *International Journal of Sustainability in Higher Education, 8*(4), 446–461.

Bernheim, B. D., & Garrett, D. M. (2003). The effects of financial education in the workplace: Evidence from a survey of households. *Journal of Public Economics, 87*(7–8), 1487–1519.

Boyle, M. E. (2004). Walking our talk: Business schools, legitimacy, and citizenship. *Business and Society, 43*(1), 37–68.

Brinkhurst, M., Rose, P., Maurice, G., & Ackerman, J. D. (2011). Achieving campus sustainability: Top-down, bottom-up, or neither? *International Journal of Sustainability in Higher Education, 12*(4), 338–354.

Cansino, J. M., Pablo-Romero, M. D. P., Román, R., & Yñiguez, R. (2011). Promoting renewable energy sources for heating and cooling in EU-27 countries. *Energy Policy, 39*(6), 3803–3812.

Clarke, A., & Kouri, R. (2009). Choosing an appropriate university or college environmental management system. *Journal of Cleaner Production, 17*(11), 971–984.

Cortese, A. D. (2003). The critical role of higher education in creating a sustainable future. *Planning for Higher Education, 31*(3), 15–22.

Dahle, M., & Neumayer, E. (2001). Overcoming barriers to campus greening: A survey among higher educational institutions in London, UK. *International Journal of Sustainability in Higher Education, 2*(2), 139–160.

Disterheft, A., da Silva Caeiro, S. S. F., Ramos, M. R., & de Miranda Azeiteiro, U. M. (2012). Environmental management systems (EMS) implementation processes and practices in

European higher education institutions—Top-down versus participatory approaches. *Journal of Cleaner Production, 31*, 80–90.

Egging, R. (2013). Drivers, trends, and uncertainty in long-term price projections for energy management in public buildings. *Energy Policy, 62*, 617–624.

Egri, C. P., & Herman, S. (2000). Leadership in the North American environmental sector: Values, leadership styles, and contexts of environmental leaders and their organizations. *Academy of Management Journal, 43*(4), 571–604.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal, 50*(1), 25–32.

Evangelinos, K. I., Jones, N., & Panoriou, E. M. (2009). Challenges and opportunities for sustainability in regional universities: A case study in Mytilene, Greece. *Journal of Cleaner Production, 17*(12), 1154–1161.

Fonseca, A., Macdonald, A., Dandy, E., & Valenti, P. (2011). The state of sustainability reporting at Canadian universities. *International Journal of Sustainability in Higher Education, 12*(1), 22–40.

Faghihi, V., Hessami, A. R., & Ford, D. N. (2015). Sustainable campus improvement program design using energy efficiency and conservation. *Journal of Cleaner Production, 107*, 400–409.

Geng, Y., Liu, K., Xue, B., & Fujita, T. (2013). Creating a "green university" in China: A case of Shenyang University. *Journal of Cleaner Production, 61*, 13–19.

González, A. B. R., Díaz, J. J. V., & Wilby, M. R. (2012). Dedicated tax/subsidy scheme for reducing emissions by promoting innovation in buildings: The EcoTax. *Energy Policy, 51*, 417–424.

Horhota, M., Asman, J. P., Stratton, J., & Halfacre, C. A. (2014). Identifying behavioral barriers to campus sustainability: A multi-method approach. *International Journal of Sustainability in Higher Education, 15*(3), 343–358.

Jabbour, C. J. C., Sarkis, J., de Sousa Jabbour, A. B. L., & Govindan, K. (2013). Understanding the process of greening of Brazilian business schools. *Journal of Cleaner Production, 61*, 25–35.

Koester, R. J., Eflin, J., & Vann, J. (2006). Greening of the campus: A whole-systems approach. *Journal of Cleaner Production, 14*(9), 769–779.

Lauder, A., Sari, R. F., Suwartha, N., & Tjahjono, G. (2015). Critical review of a global campus sustainability ranking: GreenMetric. *Journal of Cleaner Production, 108*, 852–863.

Lee, K., & Schaltegger, S. (2014). Organizational transformation and higher sustainability management education: The case of the MBA sustainability management. *International Journal of Sustainability in Higher Education, 15*(4), 450–472.

Lozano, R. (2006). A tool for a graphical assessment of sustainability in universities (GASU). *Journal of Cleaner Production, 14*(9), 963–972.

Lozano, R., Lukman, R., Lozano, F. J., Huisingh, D., & Lambrechts, W. (2013). Declarations for sustainability in higher education: Becoming better leaders, through addressing the university system. *Journal of Cleaner Production, 48*, 10–19.

Müller-Christ, G., Sterling, S., van Dam-Mieras, R., Adomßent, M., Fischer, D., & Rieckmann, M. (2014). The role of campus, curriculum, and community in higher education for sustainable development—A conference report. *Journal of Cleaner Production, 62*, 134–137.

Neumann, Y., & Neumann, E. F. (2000). The president and the college bottom line: The role of strategic leadership styles. *Library Consortium Management: An International Journal, 2*(3/4), 97–108.

Osmond, P., Dave, M., Prasad, D., Li, F., & Clayton, J. (2013). Greening Universities toolkit: Transforming universities into green and sustainable campuses—A toolkit for implementers. United Nations Environment Programme (UNEP). http://unep.org/Training/docs/Greening_University_Toolkit.pdf (Last Accessed January 15, 2016).

Soares, N., Dias Pereira, L., Ferreira, J., Conceição, P., & Pereira da Silva, P. (2015). Energy efficiency of higher education buildings: A case study. *International Journal of Sustainability in Higher Education, 16*(5), 669–691.
Townsend, J., & Barrett, J. (2015). Exploring the applications of carbon footprinting towards sustainability at a UK university: Reporting and decision making. *Journal of Cleaner Production, 107*, 164–176.
Tan, H., Chen, S., Shi, Q., & Wang, L. (2014). Development of green campus in China. *Journal of Cleaner Production, 64*, 646–653.
Vaughter, P., McKenzie, M., Lidstone, L., & Wright, T. (2016). Campus sustainability governance in Canada: A content analysis of post-secondary institutions' sustainability policies. *International Journal of Sustainability in Higher Education, 17*(1), 16–39.
Verhulst, E., & Lambrechts, W. (2015). Fostering the incorporation of sustainable development in higher education. Lessons learned from a change management perspective. *Journal of Cleaner Production, 106*, 189–204.
Wright, T. (2010). University presidents' conceptualizations of sustainability in higher education. *International Journal of Sustainability in Higher Education, 11*(1), 61–73.
Wright, T., & Horst, N. (2013). Exploring the ambiguity: What faculty leaders really think of sustainability in higher education. *International Journal of Sustainability in Higher Education, 14*(2), 209–227.
Wright, T. S., & Wilton, H. (2012). Facilities management directors' conceptualizations of sustainability in higher education. *Journal of Cleaner Production, 31*, 118–125.
Yuan, X., Zuo, J., & Huisingh, D. (2013). Green Universities in China—What matters? *Journal of Cleaner Production, 61*, 36–45.

Authors Biography

Eglė Katiliūtė is a professor at the Department of Management, School of Economics and Business, Kaunas University of Technology. Her research interests are sustainable university, sustainable development, quality management systems, higher education quality research, education policy research methodology and interdisciplinary research. She is an author of more than 40 publications.

Živilė Stankevičiūtė is a senior lecturer at the Department of Management, School of Economics and Business, Kaunas University of Technology. Her research interests are sustainable development, sustainable university, human resource management, sustainable human resource management. She is an author of more than 10 publications.

Asta Daunorienė currently employed as senior lecturer by the School of Economics and Business at Kaunas University of Technology. As a freelance consultant Asta professional expertise relates with quality management and value chain design. Asta research interests explore quality and process management, sustainable university and business models, and value chain management areas.

So Tell Me What You Want, What You Really Really Want

Including the User Perspective before Implementing Measures of Sustainability

Thomas Bäumer, Daniel Worm, Patrick Müller, Stefan Zimmermann, Tobias Popovic and Christian Pagel

Abstract

In order to reach organisational sustainability goals and to comply with increasing regulatory requirements, organisations such as universities have to decide which measures will be best suited to attain these goals. An accepted approach is to base these decisions on an assessment of hard facts that consider the effectiveness and the (financial and technical) feasibility of each measure. In this paper it is argued that the subjective user perspective (i.e. of staff members affected by these measures) is a third aspect that should be considered when evaluating the suitability of sustainability measures. Adding the user perspective will gain insights into the acceptance of potential measures and into the positive influence on users' attitudes and behaviour. In addition, not accepted measures or measures that are given low priority by users will hinder the implementation and success. This paper presents a three-part evaluation process of applied environmental management approaches such as the "eco-mapping" approach to collect environmental data on office spaces and combining these findings with the results from personal interviews with staff members occupying these office spaces. Based on the gathered information, it is possible to map different measures against the three dimensions—effectiveness, feasibility and acceptance—in order to prioritize their usefulness.

Keywords

Sustainability measures · Environmental management process · User acceptance · Participation

T. Bäumer (✉) · D. Worm · P. Müller · S. Zimmermann · T. Popovic · C. Pagel
Center for Sustainable Economics and Management, Hochschule für Technik Stuttgart (University of Applied Sciences), Schellingstr. 24, 70174 Stuttgart, Germany
e-mail: thomas.baeumer@hft-stuttgart.de

D. Worm · T. Popovic
Center for Sustainable Development, Hochschule für Technik Stuttgart (University of Applied Sciences), Schellingstr. 24, 70174 Stuttgart, Germany

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_5

1 Introduction

> There is a window in the laboratory of this building, where the rain comes in, and no one seems to be interested in this – but they are distributing blue bins for the paper trash. There seems to be something wrong when it comes to prioritization of measures. When I look at this, I think: Do you know what? With your stupid sustainability you can jump in the lake! (University Staff Member, Personal Interview, April, 2014)

When universities strive to become more environmentally sustainable organisations, officials and involved researchers are often excited. But, as can be seen in the quotation above, not all members within an organisation might share this enthusiasm. Reactions such as this demonstrate how measures implemented in order to reach sustainability goals[1] can have a negative impact on staff working within organisations. It may then negatively influence the attitudes of employees and in the long run their support when it comes to reaching the set goals. In addition, their individual attitudes and corresponding behaviours may influence other co-workers and a negative social norm may evolve from this.

In this article it is argued that the subjective user perspective is an important aspect that should be considered in addition to other more objective aspects when evaluating the suitability of environmental sustainability measures. Adding the user perspective into the environment management process will bring insights into the acceptance of potential measures and into the positive influence on users' attitudes and behaviour. The relevance of participation in the field of sustainability at universities has been highlighted in recent works (e.g. Disterheft et al. 2012, 2015; Govindarajulu and Daily 2004) and different approaches have been introduced to integrate users into sustainability processes. For example, by generally paying attention to human resource factors such as trainings, communication and empowerment (e.g. Sammalisto and Brorson 2008; Daily and Huang 2001) or more specifically by integrating all stakeholders into the setting up of an environment management process (Tinker and Tzoulas 2015). This article follows the call of Disterheft et al. (2015) to increase the body of research on participation within the context of sustainability implementation at universities—with a focus on practical ideas how to conduct participatory processes.

In the following, theoretical background information is presented regarding the three dimensions underlying the environment management process—effectiveness, feasibility and acceptance—in order to illustrate their relevance. In the second part of this article, a case study is reported, which includes all three aspects when evaluating the suitability of sustainability measures. Based on the results some conclusions are drawn on how the user perspective can be implemented as a third dimension.

[1]Goals for sustainable development can be defined regarding the economic development, social development and environmental protection (c.f. United Nations 2002). These dimensions can be described as the three pillars of sustainable development (United Nations 2005). The environmental dimension of sustainable development as one pillar focuses on the negative human impact on the improvement of ecosystem services. The example described in this paper focuses on this environmental dimension.

The outcomes of related projects will be highly relevant not just for the refurbishment of public real estate (such as universities, schools, ministries, further public authorities) but also for a large number of companies. Beginning in 2017, companies of public interest (e.g. banks) with more than 500 employees will be obliged to publish detailed sustainability reports (European Parliament 2012). If embedded in a strategic concept the affected companies should be able to realize various synergies by combining Energy-Audit and sustainability reporting (Baumgärtler and Popovic 2015).

1.1 Effectiveness/Performance Perspective

Within the context of environmental management systems such as the Eco-Management and Audit Scheme (EMAS—c.f. European Parliament 2009) organisations intend to improve their performance by reducing their environmental impact.[2] Therefore environmental relevant aspects within operational processes are evaluated to identify an organisation's current state and areas for improvement (German EMAS Advisory Board at the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety). In a second step, derived environmental measures contribute to the organisation's overall performance. Thus, the effectiveness of an improvement measure can be assessed by its contribution in improving the organisation's overall environmental performance. Since the last update of the European Regulation six areas (Energy Efficiency, Material Efficiency, Biodiversity, Water, Waste and Emissions) have been determined to present the environmental performance (European Parliament 2009).

1.2 Feasibility/Technical and Economical Perspective

Within the framework of EMAS, environmental aspects are part of an Input-Output-Analysis including all environmental relevant areas listed above. The evaluation of operational processes and subsequently the identification of areas for improvement and improvement measures are based on data that are collected during frequent review processes covering all environmental aspects. In a first step, an organisation's improvement potential is assessed focusing primarily on the effectiveness of measures.

When reviewing proposed improvement measures in a second step to discover improvement potentials, technical and economic feasibility tend to be the main criteria besides the effectiveness of the measure. On the one hand, the ease of implementation, implying a simple technological integration into the current system without major changes, indicates the preferability of a measure. On the other hand, a low investment combined with high effectiveness such as significant energy or

[2]With EMAS organizations take a proactive approach to improve their environmental performance (c.f. European Commission (2015a).

(raw) material savings, leading to tangible cost savings over time, also indicates the preferability. The projected outcome aims at the dimension of economical sustainability and is a main driver for organisations to invest in energy efficiency measures to reduce operating costs.

According to the evaluation of an organisation regarding the environmental impact and potential for improvement in the six fields, these two dimensions can be both considered to prioritize measures. As such high potential areas can be identified to significantly improve the performance while showing a high level of feasibility and effectiveness. However, this common method, when applied within organisation's environmental management systems, provides little attention to those affected by the measures and the effect it has on their behaviour.

1.3 Acceptance/User Perspective

In order to understand and predict pro-environmental behaviour, such as preserving energy at the office, various theories have been developed. One frequently used approach is the *Theory of Planned Behavior* (Ajzen 1991). It starts with the idea that (planned) behaviour is best explained by behavioural intention, which is mainly determined by three variables: attitudes, social norms, and (perceived) behaviour control. This theory views humans as rather rational beings which intend to demonstrate behaviours they believe will aid them in reaching their goals (=attitudes). However, humans are also "social animals" in a sense as they take into account how significant others may perceive their behaviour (=social norms). Humans conform to expectations of others in order to prevent being excluded by their social environment. A third important predictor is perceived behavioural control, meaning that humans will not attempt to reach the (seemingly) impossible but focus on actions within their area of control. Apart from a wide range of empirical support, this theory has also been tested for the prediction of pro-environmental behaviour, e.g. in a study investigating behavioural intentions at the workplace (Greaves et al. 2013). In this study, the three predictors accounted for 46–61 % of the variance in behavioural intention regarding various pro-environmental behaviours (e.g. switching the computer off when leaving the desk).

In a meta-analysis by Bamberg and Möser (2007), the Theory of Planned Behaviour was extended by the implications of the *Norm-Activation Model* (Schwartz 1977). According to this model, moral norms (in addition to social norms) are an additionally relevant predictor of behavioural intentions. This has already been demonstrated in the field of pro-environmental behaviours, such as energy conservation (Black et al. 1985). Taken together, these models presume that individual attitudes and social as well as moral norms are important determinants of pro-environmental behaviour. Any action that would negatively influence these variables would also have a negative impact on corresponding behaviour at the workplace as well as outside. Thus, by choosing and implementing measures in order to reach sustainability goals in organisations, one needs to be aware of the

acceptance of these measures on an individual (attitudes) as well as on a group level (norms). This is why it is necessary to include the user perspective as a third dimension, when deciding on which measure to implement in order to reach organisational sustainability goals.

Besides the importance of individual attitudes and social norms, there is a third aspect that makes the user perspective worth exploring. Resource allocation processes (the implementation of certain sustainability measures can be seen as such a process, i.e. a limited resource, money, is spent on one or more measures) have long been known to be strongly influenced by the perceived fairness of such allocations (i.e. distributive fairness) and the perceived fairness of the process of this allocation (i.e. procedural fairness). In the case of the implementation of sustainability measures, *procedural fairness* should be especially important. The perception of an individual that a certain process is fair triggers many favourable attitudes and behaviours toward the organisation implementing this process, independent of the outcome of the process. This well-researched phenomenon is called the "fair-process-effect" (Folger 1977) and has been shown in many domains of social life (c.f. Colquitt et al. 2013). Effects of favourable perceptions of procedural fairness include a more positive attitude toward the organisation implementing the process, higher compliance to the rules and regulations in the organization, more corporate citizenship behaviour, stronger endorsement of organisational goals and higher productivity (Colquitt et al. 2013). Additionally, previous research has shown that perceptions of low procedural fairness lead to negative attitudes toward the company, low endorsement of organisational goals, low rule compliance, etc. (Colquitt et al. 2013). All these effects occur regardless of the person's impressions about the actual long-term outcome of the process (in this case the actual sustainability measures). Therefore, making the process of the implementation of sustainability measures fairer should result in more positive perceptions of and behaviours towards the implemented measures.[3] But how can we render a process fair? Previous research has identified different aspects that make processes fairer, such as transparency, consistency and accountability. However, the single most influential aspect seems to be the opportunity to state ones' own opinion (Folger 1977). Voicing ones' own ideas and attitudes, regardless whether this leads to the desired outcome or not, makes people see a process as more fair.

Combining this with the above-mentioned fact, that asking people about their attitudes and social norms helps to predict their future behaviour, the mere process of asking people should also have a positive effect on their perceptions of the measures resulting from the process of identifying suitable sustainability measures.

In the following part, a case study is presented that investigated the three aspects: effectiveness, feasibility and acceptance, at the Hochschule für Technik Stuttgart (University of Applied Sciences).

[3]Fairness should not only be installed in order to increase the social aspect of sustainability, but also in order to increase acceptance and effectiveness of environmentally relevant measures.

2 Case Study at the Hochschule für Technik Stuttgart (HFT)

The presented case study is a part of an ambitious project at the HFT called "EnSign—field laboratory for climate-neutral city campus". The project has been established to pursue the state government of Baden-Württemberg's goal to build a largely carbon-neutral state administration by 2040 (Landesregierung Baden-Württemberg 2012).

With a mix of protected historic buildings, post-war constructions as well as new buildings, the building stock of the HFT is highly heterogeneous. The campus contains numerous classrooms, work and service rooms, computer centres, a cafeteria, laboratories, external firms. With more than 4000 students, technical and office employees, academic staff and professors, the user group of the campus is also very heterogeneous. When it comes to sustainable measures that will lead the goals of a "campus energy master plan", the different building requirements must be taken into account as well as the users who will have to live with it.

The presented case study had the aim to identify measures with the highest potential to reach set sustainability goals. The described approach can be separated into three different steps: The first step had the goal to identify general areas in the organisation with high potential to reach sustainability goals. The second step tried to identify potential measures in the one selected area based on the dimensions effectiveness and feasibility. The final step was the integration of the user perspective regarding the identified measures and to discuss the potential of the measures based on these results.

2.1 STEP 1: Identification of the Relevant Areas for Sustainability Goals

2.1.1 Environmental Impact

The overall target is to improve the organisation's performance by setting sustainability goals. As such the effectiveness is measured within EMAS core areas (see Table 1) and provides information on the organisation's inputs or

Table 1 EMAS core indicators and performance

Key areas	Input or impacts	Performance
Energy efficiency	Total direct energy use/Total renewable energy use	5495 MWh/30 %
Material efficiency	Annual mass-flow of different materials used	15 t of paper
Water	Total annual water consumption	7994 m^3
Waste	Total annual generation of waste/Total annual generation of hazardous waste	121 t/under 20 kg
Biodiversity	Land use	13,440 m^2
Emissions	Total annual emissions of greenhouse gases/Total annual air emissions	609 t CO_2

Table 2 Summary of the results of the eco-mapping (1100 findings)

Energy Efficiency (e.g. defects, energy losses, suggested replacement)	35 %
Safety/Soil Protection (e.g. potential threats, heath issues)	27 %
Waste Management Issues (e.g. hazardous materials, recycling issues)	22 %
Water Utilisation (e.g. defects, water losses, suggested improvements)	8 %
Emissions (e.g. local emissions, CO_2-Emissions)	8 %

environmental impacts that can be analysed by correlating the results to the organisation's size. The greater the observed improvement within the key areas, the more effective the preceding measure.

Once the performance has been evaluated, areas for improvement need to be identified that indicate the field of action, and build the basis for deriving measures in the respective field.

2.1.2 Potential for Improvement

When identifying areas for improvement, the environmental management process starts with a primary environmental review which includes the visit of all of the organisation's building areas and the collection of environmental relevant data. In the case of the HFT, the EMAS EASY concept (European Commission 2015b) was applied that consists of an eco-mapping process. The mapping of the organisation, in terms of location and internal processes in order to identify its environmental aspects, resulted in 1100 findings illustrated in Table 2. Findings contained information on environmental relevant locations on the campus and their potential for improvements regarding energy efficiency, waste management, resource use, soil protection etc. For subsequent reviews, the HFT developed an EMAS-smartphone app showing the findings on electronic floor plans and to be used by personnel to include more individual information (Fridrihsone and Kettemann 2015).

As part of the evaluation process within EMAS EASY, the common method "FLIPO" (Flow, Legislation, Impact, Practices, and Opinions) was applied. During this part of the process the collected data supported the evaluation of the organisation's operational processes. Most weighted assessment criteria of the FLIPO concept are the legal aspects regarding a work process and the processes' environmental impact. These evaluation criteria are followed by the frequency of energy/material flows as well as the evaluation of the applied technical practices. A further criterion was the opinion of experts of the corresponding operational process that was integrated as well.

2.2 Results Step 1 (Identification of Environmental Field with Highest Impact/Potential)

The results of the evaluation are summarized in Fig. 1. The illustration shows the evaluation of the university's environmental impacts from its operations and measures the potential for improvements within the environmental fields.

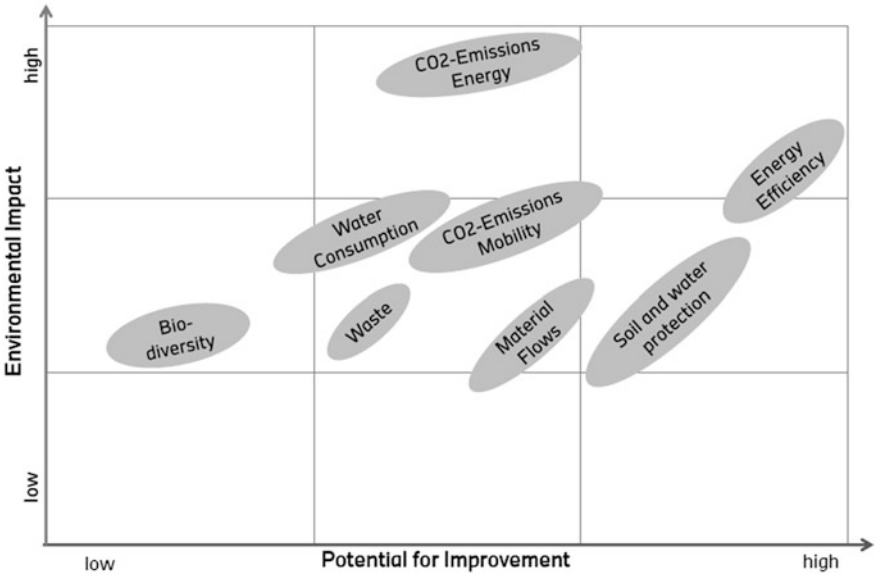


Fig. 1 Evaluation of the organisation's current state

Table 3 Standards evaluation and priorities of improvement measures

	Effectiveness	Feasibility	Priority
Hand dryer	*Low*	Medium (**High technical**, *Low financially*)	*C*
Lighting retrofit	Medium	Medium	B
Thermostat office	**High**	**High**	**A**

Based on these results, the HFT selected the field of "energy efficiency" for the following step, given the high potential for improvements and the significant environmental impact expected. Therefore, different energy efficiency measures were analysed in step two.

2.3 STEP 2: Identification of Potential Measures to Reduce Energy Consumption

Two representative buildings (out of 9) were chosen to be investigated. They were chosen given both will undergo major renovations in the near future. As such, there was a feasible opportunity to implement some of the suggested measures, which would also increase the willingness of the staff to participate as interview patners in step 3. In one building (Building 3) 43 people have their offices, while in the other (Building 4) 50 people do.

As part of the implementation of the environmental management system at the HFT, a variety of measures had already been assessed (see Table 3 for selected examples) regarding effectiveness and (technical/economical) feasibility. The retrofitting of the lighting systems shows for example technical barriers (limitation to make architectural adjustments) regarding effective measures to improve it. Although overall electricity consumption could be significantly reduced, these measures were given medium priority since they also required more individual and local solutions. Hand dryers on the contrary are simple to replace. However, investments relative to the outcome conclude an unfavourable improvement measure. Programmable digital thermostats in offices were rated with a good technical and economic feasibility and reduce the energy consumption significantly, thus indicating the preferability of this measure. However, from experiences with thermostats in lecture rooms, some problems already appeared. Users of lecture rooms individually attempt to adjust room temperatures depending on sunlight level, number of occupants or sitting location that affect the perceived temperature. The only adjustment room users can make is opening windows for fresh and cold air, which causes the thermostats to provide more heat to keep the room temperature level. Audits have shown that the interference by users results in windows that stay open until the next user group arrives later in the day or even the next day while thermostats attempt to maintain the intended room temperature.

2.4 Results Step 2 (Selection of Planned Measures)

Installing 24 efficient hand dryers for building 3 and 4 requires an investment of 26,376 EUR while the overall energy consumption will be reduced by only 0.02 %. Despite the technical feasibility being considered high, the result is still a measure of low priority (C).

An investment of 96,110 EUR on lighting retrofits in 40 lecture rooms, with a medium ease of implementation, improve the energy efficiency performance of the university by approximately 0.92 % and results in a measure of medium priority (B). An investment of only 9,415 EUR on programmable digital thermostats in offices for the two buildings with the ease of implementation being very low, improve the energy efficiency performance of the university by approximately 15 % and result in a measure of high priority (A).

From the examples mentioned above, we can learn that improvement measures that are evaluated as effective still can be found ineffective during reviews and audits. Furthermore they can even result in an increased resource use and costs. Simultaneously, users may be dissatisfied with sustainability initiatives and perceive it as a loss of comfort and autonomy. Decisions are usually made based on the hard facts alone and do not incorporate user's behaviour or the acceptance for planned changes. When disregarding the user perspective, actions may remain ineffective or the potential for improvements is not exhausted due to prevailing consideration of hard facts during the decision making process. Thus, this perspective was integrated in a final step.

2.5 STEP 3: Evaluation of Measures from the User Perspective

It was decided to use qualitative interviews in order to assess the evaluation of the selected measures. We employed a set of questions as a guideline, thus following a semi-structured approach and making the interviews comparable but also open to individual input. The qualitative approach was chosen because there was little knowledge concerning the environmental attitudes and behaviour of staff within the organisation. It was also hoped that participants would give a more detailed evaluation of their attitudes compared to an alternative quantitative approach.

In order to prepare participants for the interview, they were asked to fill out a diary three days prior to the actual interview. In this diary they had to document some of their energy consumption and energy saving behaviour. The reason for this diary was to make people become aware of the topics that were to be addressed during the interview.

The interviews took place in the offices of the respective participants given the main topic was "energy use *at the office*" and it was also convenient for participants. The interviews, lasting from 30 to 60 min, were all conducted by the same interviewer. The interviews started with questions regarding the position and working routine of the participant, followed by the subjective evaluation of the atmospheric environment in the respective office and how it could be improved. The main part of the interview concerned questions about energy usage, waste of energy and possibilities to decrease energy consumption. Participants were asked to evaluate different methods promising to decrease energy usage, including the measures in focus (hand dryer, lighting retrofit, and thermostat in offices). The interview closed with questions about the attitudes towards environmental consciousness.

It was planned to draw a sample of 10 participants for each of the two buildings, thus reaching 20–25 % of total staff. In order to gather as many different views as possible regarding the topic of energy consumption, different target groups were included in the sample design: Professors as well as other employees, men and women, and—most importantly—participants from each floor within each building. Within each sample group, participants were selected randomly from a list of all employees and then contacted by phone/email in order to set a date for the interview. Due to some not being able to participate, the final sample consisted of N = 7 interviews (building 3) and N = 6 interviews (building 4), respectively. In the end, the total sample consisted of N = 13 interviews, which is about 15 % of all staff in these two buildings. Gender was equally distributed, but only a few of the participants were professors (N = 4). There were participants for each of the four floors of the two buildings, with the exception of the ground floor in building 3.

The next section presents the evaluation of the three measures from the users' point of view. Two of the measures meet broad acceptance by the interviewed staff members but the third one is seen far more critical. See Table 4 for an overview.

At first glance it seemed that hand dryers were not positively evaluated by users. Staff members often reported that using toilet paper to dry off their hands instead of using the installed hand dryers. However, the problem seemed to be the specific

Table 4 Evaluation of improvement measures including the user perspective

	Effectiveness	Feasibility	Priority	Acceptance
Hand dryer	*Low*	Medium (**High technical**, *Low financially*)	*C*	**High**
Lighting retrofit	Medium	Medium	B	Medium
Thermostat office	**High**	**High**	**A**	*Low*

hand dryers installed in the building. Most bathrooms were equipped with out-dated hand dryers that did not work well and also too few were installed, thus displeasing staff members. Generally, hand dryers were very much desired, but only the newer generations. Acceptance of this measure was generally very high.

Lighting retrofit was also very positively evaluated, i.e. to use LED technology in the lecture halls (and offices), but only if the demands of staff members would be heard when it comes to selecting the light colour, interior design and dimming functionalities. Here some members doubted this would be the case. Acceptance for this measure is thus on a medium level.

The third measure was programmable thermostats in offices. Despite the fact that some of the interviewed people have already made positive experiences with programmable thermostats in their private households, the vast majority saw no need to use these in their professional life. Most of them expected an additional effort with programming these thermostats. Due to the need for regular replacement of batteries and the programming efforts, it appears the majority of the staff did not want upgraded thermostats in their offices. They feared that this would increase their workload and tighten their flexibility regarding working hours. This measure was not accepted at this stage.

3 Discussion and Outlook

In the reported case study three steps were used in order to identify potential measures to reach sustainability goals in an organisation. In the first step, by using the FLIPO method, energy efficiency was identified as an area with high potential for improvement as well as area for high environmental impact. Specific measures from this area were derived and evaluated in a following second step, based on the dimensions efficiency and feasibility. This led to a rank order of these measures suggesting "thermostats in offices" as a measure with high priority and "hand driers" as a measure with low priority. In a concluding third step, staff members of selected buildings were asked to evaluate these measures, which added a new dimension to the process.

According to objective evaluations, hand dryers were not a very effective and also comparably expensive measure. However, staff members would highly appreciate this measure, since it would not only reduce energy consumption (at least to some amount), but also increase comfort. It might, thus, be an effective measure to be implemented, because it would positively affect the attitudes of staff members, especially when it comes to the whole process of making the organisation more sustainable in the future. If the whole project and its outcomes were seen in a positive light, staff members were more likely to support it, even if less pleasant measures were to be implemented in the future. The overall acceptance would rise. This measure could, thus, be used as an "admission ticket" for the overall process.

To install programmable thermostats in offices seemed to be an effective measure based on objective evaluation, especially due to relatively low costs. Staff members would have the opportunity to program the heating system according to their individual demands. Some staff members were also already used to these thermostats from their private homes. Surprisingly, there was little support for this idea for their offices. Staff members feared that programming would be a hassle (reducing comfort) and would reduce their flexibility, e.g. when they wanted to work late some days and start early on others. Even though acceptance was low for this measure, it does not mean that it is unacceptable per se, but, before implementing it, concerns of staff members have to be heard and addressed.

Regarding the third measure (LED lamps), a comparably costly measure, there was some doubt regarding the possibility to find acceptable lighting settings for all staff members. An additional problem arose due to the demand for dimmable lighting. This would cause additional costs, thus decreasing the economic feasibility of this measure.

To conclude, by taking the view of staff members into account, evaluation of measures became more differentiated, but also somewhat more diverse. For example, the dimension of increased comfort showed to be relevant to users when evaluating selected measures. Generally, this underlines the necessity to include the voice of staff members before implementing any of the suggested measures. By giving them a voice during the decision process, acceptance for this measure might rise. This aspect is especially relevant for organisations with low turnover rates, such as a state university. But even for organisations with high turnover rate, employers would only have to be asked once during the process of decision making – whenever a new process for other measures start, this might be necessary again. This could be done, as suggested in the presented case study, by using qualitative interviews as a viable way to reach staff members and to gain a differentiated and deep understanding of their perspective. Qualitative interviews are though also time-consuming. One might think about other ways to assess user evaluations in an organisation in addition to or as an alternative to qualitative interviews. Quantitative online interviews for example are a rather efficient method and could prove to be successful if kept to an answer time of 5–10 min. Perceived anonymity could increase the honesty of the answers, but dropout rate has not been tested so far.

4 Conclusion

Through a case study, it was demonstrated that it is worthwhile to integrate the user perspective when evaluating potential sustainability measures. Using a bottom-up participatory approach does not only assist in identifying measures that are accepted by users (e.g. hand dryers), but also to gain ideas in how to overcome barriers that hinder acceptance for other measures (e.g. thermostats in offices). In addition, potential drivers could be derived based on relevant motives of staff members (e.g. need for comfort). Taking this information into account would, in the long run, increase the commitment to and support for the overall process at an organisation trying to reach certain sustainability goals. In addition, the risk of resistance regarding chosen measures and the general environment management process is reduced (c.f. Tinker and Tzoulas 2015). It is, therefore, suggested to integrate the user perspective into any planning process that (directly or indirectly) affects users. It is beneficial to integrate the user perspective at an early stage and continuously e.g. into EMAS instruments such as HFT's EMAS-App for staff members (Fridrihsone and Kettemann 2015). This would also lead to higher acceptance within organisations and also outside by positively influencing users' attitudes. The EMAS process at the HFT will be complemented accordingly in the future.

Acknowledgments This research within EnSign project is founded by the Ministry of Science, Research and the Arts Baden-Württemberg, Germany. We also thank our reviewers for their helpful comments on an earlier version of this paper.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. doi:10.1016/0749-5978(91)90020-T

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology, 27*(1), 14–25. doi:10.1016/j.jenvp.2006.12.002

Baumgärtler, T., & Popovic, T. (2015). Nachhaltigkeit in der DNA. In Dz Bank (Hg.) 2015—Nachhaltigkeitsbericht 2014 (p. 37).

Black, J. S., Stern, P. C., & Elworth, J. T. (1985). Personal and contextual influences on household energy adaptations. *Journal of Applied Psychology, 70*(1), 3–21. doi:10.1037/0021-9010.70.1.3

Colquitt, J. A., Scott, B. A., Rodell, J. B., Long, D. M., Zapata, C. P., Conlon, D. E., et al. (2013). Justice at the millennium, a decade later: A meta-analytic test of social exchange and affect-based perspectives. *Journal of Applied Psychology, 98*(2), 199–236. doi:10.1037/a0031757

Daily, B. F., & Huang, S. (2001). Achieving sustainability through attention to human resource factors in environmental management. *International Journal of Operations & Production Management, 21*(12), 1539–1552.

Disterheft, A., Caeiro, S., Azeiteiro, U. M., & Leal Filho, W. (2015). Sustainable universities: A study of critical success factors for participatory approaches. *Journal of Cleaner Production, 106*, 11–21.

Disterheft, A., da Silva Caeiro, S. S. F., Ramos, M. R., & de Miranda Azeiteiro, U. M. (2012). Environmental management systems (EMS) implementation processes and practices in European higher education institutions: Top-down versus participatory approaches. *Journal of Cleaner Production*, *31*, 80–90.

European Parliament. (2009). Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC.

European Parliament. (2012). Directive 2012/27/EU of the European Parliament and of the council of 25 October 2012.

European Commission. (2015a). EMAS—The European Eco-Management and audit scheme. http://ec.europa.eu/environment/emas/about/index_en.htm. Accessed January 06, 2016.

European Commission. (2015b). EMAS Easy. http://ec.europa.eu/environment/emas/tools/emaseasy_en.htm. Accessed January 25, 2016.

Folger, R. (1977). Distributive and procedural justice: Combined impact of voice and improvement on experienced inequity. *Journal of Personality and Social Psychology, 35*(2), 108–119. doi:10.1037/0022-3514.35.2.108

Fridrihsone, A., & Kettemann, R. (2015). Eco GIS—Spatial facility management as ArcGIS online app. 2015 Esri user conference paper sessions, San Diego, California.

German EMAS Advisory Board at the Federal Ministry for the Environment, Nature conservation, building and nuclear safety EMAS—Ablaufschritte. http://www.emas.de/teilnahme/ablauf/ablaufschritte. Accessed January 07, 2016.

Govindarajulu, N., & Daily, B. F. (2004). Motivating employees for environmental improvement. *Industrial Management & Data Systems, 104*(4), 364–372. doi:10.1108/02635570410530775

Greaves, M., Zibarras, L. D., & Stride, C. (2013). Using the theory of planned behavior to explore environmental behavioral intentions in the workplace. *Journal of Environmental Psychology, 34*, 109–120. doi:10.1016/j.jenvp.2013.02.003

Landesregierung Baden-Württemberg. (2012). Nachgefragt bei Kretschmann: Auf dem Weg zur klimaneutralen Landesverwaltung. https://www.baden-wuerttemberg.de/de/service/media/mid/weg-zur-klimaneutralen-landesverwaltung/. Accessed January 25, 2016.

Sammalisto, K., & Brorson, T. (2008). Training and communication in the implementation of environmentalmanagement systems (ISO 14001): A case study at the University of Gävle, Sweden. *Journal of Cleaner Production, 16*, 299–309.

Schwartz, S. H. (1977). Normative influence on altruism. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (pp. 221–279). New York: Academic Press.

Tinker, H., & Tzoulas, K. (2015). The benefits and challenges of developing and implementing an environmental management system using a participatory approach: A case study of Manchester Metropolitan University, UK. In L. Leal Filho, U. M. Azeiteiro, S. Caeiro and F. Alves (Eds.), *Integrating Sustainability Thinking in Science and Engineering: Innovative Approaches, Methods and Tools* (pp. 325–438). Springer, Heidelberg.

United Nations. (2002). Report of the world summit on sustainable development: Johannesburg, South Africa, 26 August-4 September 2002. A/CONF.199/20, New York.

United Nations. (2005). United nations general assembly: World summit outcome. Resolution A/60/1.

Strategic Performance of Sustainable Campus Development: Case Study of a Multi-campus Tertiary Institution in a Highly Dense City of Asia

Simon Leung and Artie W. Ng

Abstract

Tertiary institutions around the world have attempted to embrace sustainability in their campus development. Complementary initiatives are made to uphold social responsibilities to the community and the environment. Such campus development could nurture a culture whereby the stakeholders are able to learn about effective ways to enhance sustainability. Hong Kong, as a global financial center in Asia, has developed initiatives to support sustainable development in both public and private sectors. Through case study of a tertiary institution with multiple campuses in Hong Kong, a strategic approach to develop a sustainable campus is revealed. This study looks into a leadership-driven method reinforced by comprehensive policy, multi-disciplinary team, technological infrastructure as well as a detailed implementation plan. A framework for strategic performance of sustainable campus is constructed to illustrate allocation of resources accompanied by knowledge gained from the main campus that facilitates learning among the affiliated campuses and their communities.

Keywords

Sustainable campus development · Strategic performance · Hong kong · Asia

S. Leung · A.W. Ng (✉)
The Hong Kong Polytechnic University, Kowloon, Hong Kong, China
e-mail: spartie@speed-polyu.edu.hk

S. Leung
e-mail: ccsimon@hkcc-polyu.edu.hk

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_6

1 Introduction

Sustainable campus development has gained momentum among tertiary institutions in advanced economies, particularly in North America and Western Europe, in the past decade. Such a trend has been extended into Asia Pacific. Hong Kong, as the global financial center of China, has been adopting pertinent international approaches and standards in the course of maintaining its international competitiveness and relevance. With respect to sustainability, its government recognizes that a sustainable future for the city requires a public policy to promote a balance between economic and social developments with adequate conservation of the environment. As a highly dense city with high rises, its various economic sectors are encouraged to collaborate to achieve a level of sustainability.

Top tertiary institutions in Hong Kong have recognized such imperative development on a global basis and taken initiatives to facilitate programs of sustainability as an integral part of their institutional development strategy. The eight government-funded institutions formed the Hong Kong Sustainable Campus Consortium (HKSCC) in 2010 and signed a declaration with a statement of the following principles: "*(i) the importance of climate change and sustainable development for the universities' core mission of research, teaching, and knowledge exchange; (ii) the ethical obligation of educators to provide students, as the future leaders and decisions makers of society, with a thorough understanding of the nature of environmental, social and economic sustainability challenges; the opportunity for universities to serve as models within the community; and their responsibility to work across the community to forge appropriate solutions*" (HKSCC 2016).

This Chapter aims to provide an example of a structured plan and implementation of a campus sustainability initiative by one of the eight government-funded tertiary institutions based in Hong Kong, China—The Hong Kong Polytechnic University (PolyU) and its systematic approach to extend such initiative across its multiple campuses for achieving a sustainable built environment. Building on a dynamic strategy model, it suggests a range of resource allocation processes that exploit the existing intellectual capital for sustainability performance that embraces contributions by both staff and students who spend their daily lives on campus. An interactive, dynamic process among these stakeholders with timely monitoring and reporting of adopted indicators is considered to be important for the institution to sustain this movement for campus sustainability.

Utilizing a case study method, the author illustrates how complementary efforts driven by a leadership-driven policy and strategic involvement of key stakeholders would facilitate progress in sustainability performance. In particular, the leadership of the institution aspires to raise awareness for sustainability among the stakeholders facing increasingly challenging issues with environmental sustainability. Such awareness could turn into competence through programs of activities as well as education and learning on campus.

2 Sustainable Campus Development as a Global Initiative

Sustainable campus development has been growingly a global phenomenon as tertiary institutions being the cradle of the intellectuals are looked upon when tackling the challenges for the world's sustainability. In the past couple of decades, collaboration among tertiary institutions around the world appears to have gained momentum on sharing knowledge about sustainability performance. Shriberg (2002), particularly, pointed out the benefits of cross-institutional assessments, including "*identifying and benchmarking leaders and best practices; communicating common goals, experiences, and methods; and providing a directional tool to measure progress toward the concept of a sustainable campus*". It is advocated that assessment tools would help identify attributes of a sustainable campus, suggesting importance of measurability and comparability, including eco-efficiency, processes and motivational elements that are meaningful to stakeholders. Through sustainable development, tertiary institutions around the world have aspired to generating pertinent knowledge while creating positive impact on the development of competencies and awareness about sustainability (Rieckmann 2012).

Prior studies have also revealed various efforts by tertiary institutions to develop sustainable campus and education among advanced economies. For instance, Adomssent et al. (2007) provided empirical evidence from Germany on successful development of transdisciplinary techniques for sustainability in higher education institutions. Further, it highlighted the need to establish a level of collaboration among sustainability activists within universities as well as of the significance of higher education policy and administration (Adomssent et al. 2007). In Canada, Helferty and Clarke (2009) reported that students are able to lead various types of campus climate change-related initiatives with support granted by key campus stakeholders as they are empowered to take up a variety of leadership roles in such initiatives. Youth engagement is frequently found positive in a range of activities from socialization to influencing the decision makers. Looking into the experience of promoting sustainable development in UK, Lozano (2010) revealed that it is effective to incorporate sustainability concept into curricula that is more balanced, synergistic, trans-disciplinary, and holistic perspectives, in comparison with a tradition of "*compartmentalization, over-specialization, and reductionism*".

In the U.S., White (2014) unveiled that plans for campus sustainability among tertiary institutions are rather diverse; nevertheless, it is found that environmental issues are considered most significant in these plans whereas social equity aspects are treated as the least. As campus operations would typically gain more attention than the academic or administrative aspects, the experience in the U.S. urges that campuses would take a campus-wide approach in developing their sustainability plans jointly with their stakeholders (White 2014).

3 Sustainable Campus Development in Asia

As the region of the fastest economic growth in the world, Asian nations face challenges of maintaining a steady pace of economic development and modernization, while maintaining a quality living environment being deteriorated by pollution (Westphal et al. 2013). Such concerns are increasingly noticeable on a global basis with the recent attention to mitigating the impacts of climate change. It is inevitable that Asian nations are expected to take a share of such responsibility and accountability. In response to such concerns, it is articulated that the Asia-Pacific region could offer various innovative initiatives in education about sustainable development so as to strengthen understanding about the dimensions of sustainability (Ryan et al. 2010). As the region continues to follow such a global trend, a systematic development approach in the education sector via strategic integration within the tertiary institutions is advocated. These nations could harness a national approach in order to reinforce their local initiatives (Ryan et al. 2010). With such an approach, tertiary institutions could incorporate education about sustainable developments in higher education curricula while emphasizing collaboration with external stakeholders.

Given the traditional guardian culture of the East, a strategic initiative directed from the senior, authority of a state or an organization is considered instrumental for successful implementation. With an initial top-down approach, Nomura and Abe (2010) revealed the significance of the initiatives taken by the Government of Japan in enhancing education about sustainability. It is also observed that leadership development for sustainability among senior management of Japanese tertiary institutions is the key for continuing and strengthening such efforts (Nomura and Abe 2010).

In a recent study, Wu et al. (2015) further delivered an empirical study about the current state of sustainability education in Asia. Their study points out that there is an opportunity for interdisciplinary integration despite the current imbalance among the sustainability courses offered by business, science and engineering schools. It suggests that Asian universities could further their international connection while promoting actively about sustainability education via their websites (Wu et al. 2015).

4 Strategic Approaches for Performance of Sustainable Campus

Development of sustainable campus is a concept that has been actively converted into implementations throughout the recent years. There are noticeable challenges for tertiary institutions to ensure that such implementations are going to be endurable and sustained over traditional mindsets (Lozano 2006). To deal with a number of associated challenges, Adomssent et al. (2007) emphasized that a systemic approach is very much needed to support collaboration during

implementation, namely organizational management, research, teaching, so as to create necessary strategic relationships and synergies. In a recent study, a number of key factors were identified by James and Card (2012) for contribution to environmental sustainability with reference to the experience of several institutions: (i) green campus operation measures; (ii) campus administration; (iii) organization, and leadership; (iv) teaching, research, and service; (v) campus-wide actions and activities; (vi) institutional assessment of campus sustainability measures; and (vii) established methods for overcoming barriers.

Another study has in fact revealed that a key challenge for programs on sustainable campus around the world is about maintaining the institutional momentum while progressing after the initial takeoff (Wiek et al. 2014). It is similarly challenging for an institution to address this issue by reinforcing program coordination, integrating learning from the past, monitoring and evaluating impacts, as well as developing relevant training programs for both faculty and students. To deal with these issues, Too and Bajracharya (2015) have developed their 6-P framework for community engagement composed of evaluating psychological needs, physical facilities, personal motivations, public perception, price mechanisms and pertinent policies. Their case studies of two universities' sustainability projects illustrate that the framework could be applicable to various university communities (Too and Bajracharya 2015).

5 RBV and Dynamic Strategy for Sustainable Campus Development

Considering tertiary institutions being organizations that need to formulate their own strategies for development and growth, their effective utilization of resources for their sustainable campus development cannot be underestimated. With a resource-based view (RBV), Penrose (1959) long pointed out that a firm needs to optimally allocate resources to facilitate their growth and development through a dynamic process. A static framework however would not be as effective in enabling a strategy for nurturing incremental performance. Nonetheless, one should realize that strategic decisions are made incrementally rather with multitude of significant decisions at various levels within an organization (Bower 1970). For sustainable developments, one may deploy the lens of emergent strategy, as explored by Mintzberg (1978), who suggested the importance of observing the interaction between an organization and its external environment. Further, an emergent strategist would examine the convergence of intelligence and actions from multiple sources as they integrate into a kind of pattern.

The criticalness of RBV was reinforced by Barney (1991) through studying about how business entities in an industry manage to perform more successfully than the others. Strategy formation and implementation is remarked as an ongoing, never-ending, integrated process requiring continuous reassessment and reformation (Markides 1999). Rugman and Verbeke (2002) also noted the significant implications of RBV for the study of strategic management as organizations need to continue to develop its business system in order to improve performance over time. A recent study on dynamic resource management among new ventures also reveals a dynamic model of strategy and performance so as to underpin a trajectory of development (Ng et al. 2014).

To facilitate effective development of sustainability initiatives for an organization, it is critical to implement certain management control and performance measurement mechanism. As studied by Dai et al. (2013), sustainability issues can be embedded in the management control system to operationalize firms' corporate social responsibility (CSR) objectives and strategies. Such CSR activities can be categorized into a so called "Strategic CSR agenda" in which a belief system and interactive uses of management control system can be effective in facilitating the selection and implementation of Strategic CSR programs (Dai et al. 2013). With respect to measuring performance on sustainability of an organization, a sustainability performance scorecard is advocated for measuring past performance as well as evaluating existing programs and plans in place (Ng and Nathwani 2012).

6 Framework

As suggested by Adomssent et al. (2007), a systemic approach is viewed critical to seek supporting collaboration, strategic relationships and synergies for sustainable campus implementation and development. With reference to RBV and pertinent literature review, a framework of dynamic strategy and resource allocation for sustainable campus development is illustrated in Fig. 1. It demonstrates the interrelationship between leadership-driven strategy, a committee for implementation as well as programs of activities for sustainable campus (James and Card 2012). The involvement of both internal and external stakeholders is particularly crucial for their participation in day-to-day operations and education about sustainability. Overall, an interactive process of planning and performance monitoring is necessary for enhancing a continuous improvement mechanism for sustainable campus development.

Referring to the key factors contributing to environmental sustainability as identified by James and Card (2012), Table 1 highlights the main strategic initiatives as well as programs of activities that require allocation of resources for implementation.

Fig. 1 Framework of strategic performance for sustainable campus development. *Source* The authors

Table 1 Strategic initiatives for environmental sustainability (Adapted from James and Card 2012)

Main Strategic Initiatives and Related Activities
• Teaching and research activities
• Green campus administration and operations
• Campus development initiatives
• Knowledge transfer across and outside campuses
• Overcoming barriers through continuous improvement

7 The Case in Point

Hong Kong, as a global financial center in Asia, has developed initiatives to support sustainable development in both public and private sectors. Through case study of a tertiary institution with multiple campuses in Hong Kong, a strategic approach to develop its sustainable campuses is revealed. Yin (2009) noted that the case study methodology can be adopted in a number of situations to explore new knowledge of organizational, social, political, and related phenomena. This case study strategy is adopted as there is no requirement on the control of behavioral events but rather a focus on contemporary events.

This case study aims to look into a leadership-driven method reinforced by a tertiary institution's comprehensive policy, multi-disciplinary team, technological infrastructure as well as a detailed implementation plan. Building on a framework for sustainable campus development, it attempts to illustrate that knowledge gained

from the main campus is leveraged for learning among the affiliated campuses and their communities. Multiple sources of evidence, such as various publicly available documents, guidelines and reported, have been collected, reviewed and analyzed. Performance indicators initially adopted to help measure and evaluate sustainability performance over time have been looked into and revealed as well.

7.1 Hong Kong as a Sustainable, Global Financial Centre of China

Hong Kong is an international city full of high-rise buildings. Indeed, almost 90 % of its electricity consumption is building-related. There is a policy by the government to improve the city's energy efficiency so as to reduce greenhouse gas emissions from the power generating facilities that utilize fossil fuels by promoting energy efficiency in buildings. The government also strives to enhance the quality of the living environment through a range of activities, including active planting, effective maintenance and preservation of trees in connection with vegetation programs. The objective is to enable improvement in urban greenery, to extend green areas, as well as to increase quality greening opportunities among various public work projects.

The concept of green building has been actively put into practice through integration into the design of government buildings. Besides implementing greening at ground levels, there are plans in place to expand the greening areas in government buildings, such as roof greening. Since 2001, the government has instituted projects for featuring roof greening designs into some of the new government building projects. Furthermore, the government has also introduced retrofitted roof greening to the buildings where appropriate. Roof greening has provided additional green spaces, enhanced cityscape and effective heat insulation. When applied on a large scale, it can attenuate urban heat island effect as well. In addition, vertical greening has been adopted in some government capital works for improvement of the site amenity and air quality in the area. These green building features have been introduced to schools, hospitals, offices, community centers, etc.

To attain the targets set in its policy, Hong Kong has formulated a range of strategies aiming to enhance the collaboration among the greening efforts by both the public and private sectors with community participation in promoting environmental sustainability. Some of these initiatives undertaken include active planning and greening programs. The Council for Sustainable Development was established in March 2003 to promote sustainable development in Hong Kong. Seeking inputs from different stakeholders in the society, it has a mandate to facilitate community participation in the promotion of sustainable development in Hong Kong through various means and to promote public awareness and understanding of the principles of sustainable development.

7.2 PolyU's Governance, Leadership and Policy for Sustainability

As a public university funded by Hong Kong's University Grants Committee (UGC), The Hong Kong Polytechnic University (PolyU) has its main campus located in the center of a populated city with over 20 largely inter-connected buildings. These buildings provide facilities for classrooms, laboratories and other complementary academic facilities, such as sports, recreational and catering facilities, as well as student hostels and a multi-purpose auditorium. In addition, the Hong Kong Community College (HKCC) is a self-financed post-secondary institution established in 2001 under the auspices of PolyU offering a portfolio of associate degree and higher diploma programs. Programs and courses offered by HKCC and its affiliated institutions—School of Professional Education and Executive Development (SPEED) that offers top-up degrees are conducted on Hung Hom Bay Campus and West Kowloon Campus. PolyU as a whole is known as the largest government-funded tertiary institution in Hong Kong with over 32,000 students.

Under the PolyU's Principles of Governance, Social Responsibility is determined to be one of the four principles for the operations and development of the tertiary institutions.[1] Such a principle is considered in alignment with sustainable campus development. Over the past decade, The Hong Kong Polytechnic University (PolyU) has developed mechanisms to integrate sustainability principles into campus operations, developments and programmer curricula, in particular, to promote sustainability through knowledge transfer to the community.

To facilitate commitment to campus sustainability, the leadership of the institution has conveyed openly through various communication channels, including public speeches and strategic plans. PolyU has now instituted Sustainability Policy to set out the guiding principles for achieving sustainable excellence and nurturing environmental awareness in future generations. It pledges to uphold sustainability values through by sustainability practices, advance knowledge of sustainability and achieve excellence in sustainability.

7.3 Campus Sustainability Committee

As announced by the Senior Management in November 2011, the Campus Sustainability Committee (CSC) was formed to engage in promoting sustainability in planning, development and operations of the campus environment and facilities. Other sustainability initiatives in education, research and community service activities are intended to be developed by CSC. Inviting senior members of PolyU, including the Vice Presidents, Faculty Deans and Heads of Departments, CSC directly reports to the President of PolyU on campus sustainability issues.

[1]These four principles are: (a) Academic Freedom and Autonomy, (b) Transparency and Public Accountability, (c) Performance, Ethics and Professionalism, and (d) Social Responsibility.

Table 2 Programs of activities

Strategic initiatives	Programs of activities that require allocation of resources
Teaching and research activities	Embedding sustainability concepts and practice into teaching (such as General University Requirements), scholarly and research activities
Green campus administration and operations	Compliance with relevant environmental laws and regulations and remain vigilant against the possibility of negative environmental consequences through "reduce, reuse and recycle"
Campus development initiatives	Assessing the environmental, socio-economic impact of campus development initiatives, incorporating sustainable design and construction features into infrastructure
Knowledge transfer across and outside campuses	Building a knowledge sharing platform for sustainable global community, encouraging all members of the University to participate in sharing knowledge and achievements derived from research efforts and good practices
Overcoming barriers through continuous improvement	Applying a mechanism of continuous review and evaluation with a view to improving sustainability performance

Source CSC and the authors

Through CSC, a number of programs of activities for sustainable campus have been launched in supporting specific strategic initiatives. Table 2 summarizes the major strategic initiatives of CSC and its corresponding programs of activities that require allocation of resources for implementation by PolyU.

Further, between 2006 and 2012, a number of sustainable campus initiatives have been taken with noticeable milestones. Back in 2006, PolyU was committed to the Carbon Reduction Charter initiated by the Environmental Protection Department of the Government. It subsequently joined the Hong Kong Sustainable Campus Consortium in 2010 before setting up its CSC in 2011 and issuing its Sustainability Report in 2012.[2]

7.4 Multiple-Campus Environment and Complementary Infrastructure

Further, there are a number of green-initiatives at PolyU's main campus through infrastructural development embedded within its buildings. For instance, it has incorporated features, such as public green area, water-cooled chillers installed on building roofs as well as solar-photovoltaic system on roof (see Figs. 2, 3 and 4).

Both Hung Hom Bay (HHB) and West Kowloon (WK) campuses have adopted the Sustainability Policy of PolyU which was first implemented on the main

[2]PolyU commissioned Hong Kong Quality Assurance Agency (HKQAA) to conduct an independent verification of its 2011/12 Sustainability Report.

Fig. 2 Public open space and green area. *Source* Hong Kong Polytechnic University (2012)

Fig. 3 Water-cooled Chillers. *Source* PolyU 2011/12 sustainability report

Fig. 4 Solar-panel Roof. *Source* PolyU 2011/12 sustainability report

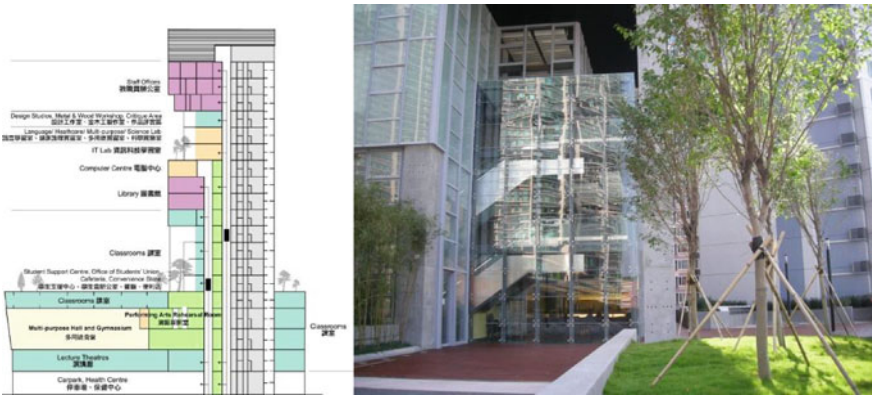


Fig. 5 Sky Garden at HHB campus. *Source* CPCE, PolyU

campus. Back in 2008, recognizing the unique green features of the HHB Campus, the Professional Green Building Council in Hong Kong granted the Merit Award (New Construction Category) to HHB Campus recognizing the outstanding green design of the campus building. For instance, a Sky Garden was part of the green features embedded into the building to enable a common area of green living within a highly dense, vertical environment (see Fig. 5). In fact, the campus was noticeably the first educational building in Hong Kong which has been awarded such an exceptional rating. The WK Campus, on the other hand, was selected as one of the six finalists for the WAN Education Award 2009 organized by World Architecture News (WAN), a leading architectural media organization.

Complementing the development of green infrastructures, PolyU has initiated programs of activities that involve participation of students in sustainable development projects. For example, it has launched a Green Lifestyle Series to encourage students to develop creative ideas for green living (see Fig. 6).

7.5 Adopting Performance Measurement

During the initial planning and development, relevant performance indicators were adopted to extract quantitative data for year-to-year analysis in the past years. As provided in the 2011/12 Sustainability Report released by PolyU, a range of environmental performance data over the previous four years. The purpose was mainly to monitor the consumption of energy, water and materials as well as the amounts of waste disposed and collected for recycle. Such reported data would enable both internal and external stakeholders to look into areas of further improvement on a continuous basis for reference. Appropriate resource allocation for implementation of improvement programs can be formulated upon evaluation of such performance indicators.

Fig. 6 Green Lifestyle Series Poster. *Source* CPCE, PolyU

To provide specific performance measurement, detailed analysis of recyclable waste materials by type were provided from 2008/09-2011/12 (Fig. 7). This detailed analysis enables better understanding about the source of the waste materials for potential reduction in the future. With respect to data on carbon emission, an analysis on carbon emission per GFA (ground floor area) was also produced in the report for comparison of annual performance (Fig. 8).

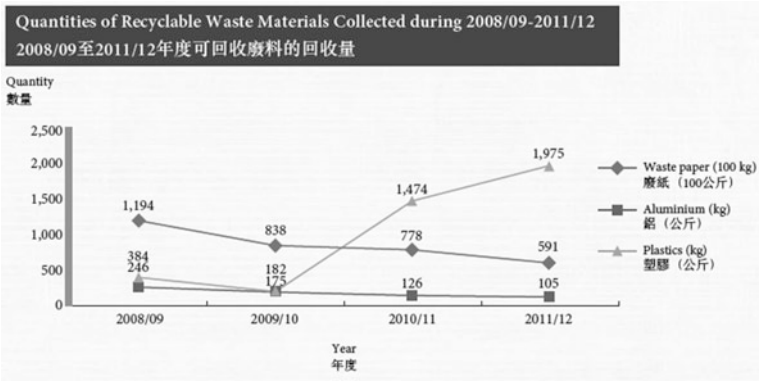


Fig. 7 Analysis of recyclable waste materials. *Source* Hong Kong Polytechnic University (2012)

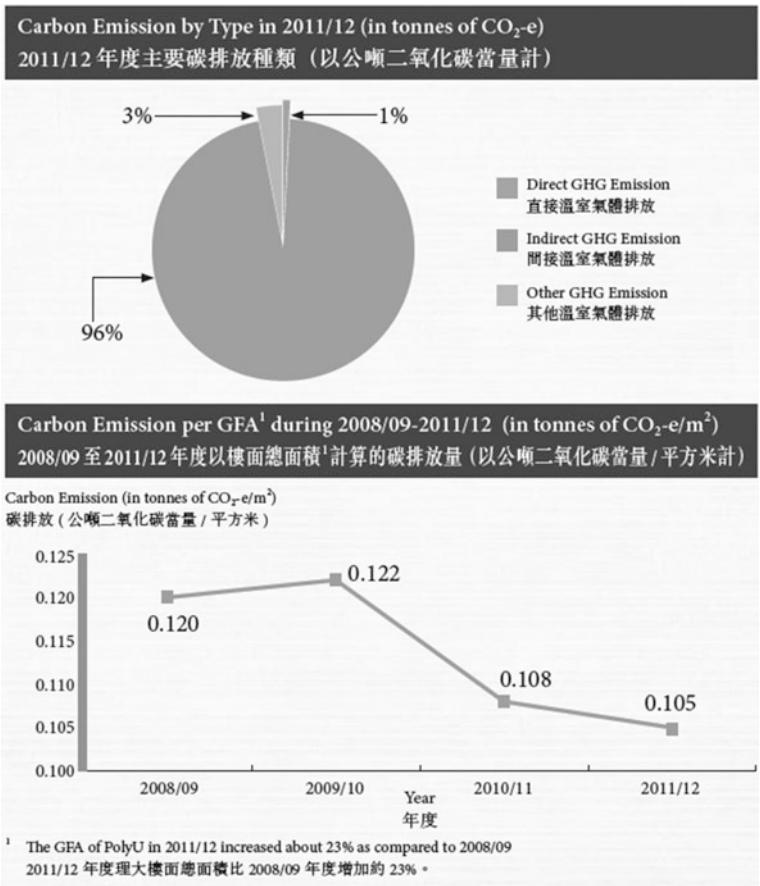


Fig. 8 Analysis of carbon emission. *Source* Hong Kong Polytechnic University (2012)

8 Concluding Remarks

Through the case study of PolyU, this Chapter articulates the approach adopted by the tertiary institution in Hong Kong in facilitating sustainable campus operations and development that embraces its embedded infrastructural characteristics, on-going efforts for sustainability, as well as the complementarity of tangible and intangible assets as critical resources. PolyU's multiple campuses represent the uniqueness of this institution that is built within a highly dense city with limited land and spaces where its architectural and common-area design is optimized under such physical constraints for incorporation of innovative green features.

Nevertheless, similar to the approach adopted by overseas tertiary institutions (Adomssent et al. 2007; James and card 2012), PolyU has adopted a systematic approach to engage stakeholders for its sustainable campus initiatives. Similar to other institutions in Asia, PolyU has made use of a leadership-driven approach with development of policy and mandates enhanced by formation of a committee taking on wisdom of various campus stakeholders of multiple-disciplines (Nomura and Abe 2010; Wu et al. 2015). It demonstrates that a tertiary institution can be driven to engineer performance and innovation for sustainability through adequate campus planning and effective execution.

References

Adomssent, M., Goodman, J., & Michelson, G. (2007). Transferability of approaches to sustainable development at universities as a challenge. *International Journal of Sustainability in Higher Education, 8*(4), 385–402.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120.

Bower, J. L. (1970). *Managing the resource allocation process: A study of corporate planning and investment*. Boston, MA: Harvard Business School.

Dai, N. T., Ng, A., & Tang, G. (2013). Corporate social responsibility and innovation in management accounting. *Chartered Institute of Management Accountants Research, 9*(1), 1–13.

Helferty, A., & Clarke, A. (2009). Student-led campus climate change initiatives in Canada. *International Journal of Sustainability in Higher Education, 10*(3), 287–300.

Hong Kong Sustainable Campus Consortium. (2016). http://www.hkscc.edu.hk/about (Last Accessed January 23, 2016).

Hong Kong Polytechnic University. (2012). Sustainability Report. http://www.polyu.edu.hk/hseo/Environmental_Report/sr_2011_12.pdf (Last Accessed September 28, 2016).

James, M., & Card, K. (2012). Factors contributing to institutions achieving environmental sustainability. *International Journal of Sustainability in Higher Education, 13*(2), 166–176.

Lozano, R. (2006). Incorporation and institutionalization of SD into universities—breaking through barriers to change. *Journal of Cleaner Production, 14*, 787–796.

Lozano, R. (2010). Diffusion of sustainable development in universities' curricula: An empirical example from Cardiff University. *Journal of Cleaner Production, 18*, 637–644.

Markides. C. (1999) A dynamic view of strategy. *MIT Sloan Management Review*, *40*(Spring), 55–63.

Mintzberg, H. (1978). Patterns in strategy formation. *Management Science, 24*(9), 934–948.

Ng, A. W., & Nathwani, J. (2012). Sustainability performance disclosures: The case of independent power producers. *Renewable and Sustainable Energy Reviews, 16*(4), 1940–1948.

Ng, A. W., Macbeth, D., & Southern, G. (2014). Entrepreneurial performance of early-stage ventures: Dynamic resource management for development and growth. *International Entrepreneurship and Management Journal, 10*(3), 503–521.

Nomura, K., & Abe, O. (2010). Higher education for sustainable development in Japan: Policy and progress. *International Journal of Sustainability in Higher Education, 11*(2), 120–129.

Penrose, E. (1959). *The theory of the growth of the firm*. Oxford: Oxford University Press.

Rieckmann, M. (2012). Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? *Futures, 44*, 127–135.

Rugman, A., & Verbeke, A. (2002). The contribution of Edith Penrose to the resource-based view of strategic management. *Strategic Management Journal, 23*, 769–780.

Ryan, A., Tilbury, D., Corcoran, P. B., Abe, O., & Nomura, K. (2010). Sustainability in higher education in the Asia-Pacific: Developments, challenges, and prospects. *International Journal of Sustainability in Higher Education, 11*(2), 106–119.

Shriberg, M. (2002). Institutional assessment tools for sustainability in higher education: Strengths, weaknesses, and implications for practice and theory. *International Journal of Sustainability in Higher Education, 3*(3), 254–270.

Too, L., & Bajracharya, B. (2015). Sustainable campus: Engaging the community in sustainability. *International Journal of Sustainability in Higher Education, 16*(1), 57–71.

Westphal, M. I., Hughes, G. A., & Brömmelhörster, J. (2013). *Economics of climate change in East Asia*. Asian Development Bank.

White, S. S. (2014). Campus sustainability plans in the United States: Where, what, and how to evaluate? *International Journal of Sustainability in Higher Education, 15*(2), 228–241.

Wiek, A., Xiong, A., Brundiers, K., & van der Leeuw, A. (2014). Integrating problem- and project-based learning into sustainability programs. *International Journal of Sustainability in Higher Education, 15*(4), 431–449.

Wu, Y. J., Shen, J., & Kuo, T. (2015). An overview of management education for sustainability in Asia. *International Journal of Sustainability in Higher Education, 16*(3), 341–353.

Yin, R. K. (2009). *Case study research: Design and methods*. Sage.

Author Biographies

Simon Leung is Director of the Hong Kong Community College at The Hong Kong Polytechnic University (PolyU) as well as Associate Dean (Development) of College of Professional and Continuing Education (CPCE) at PolyU. Dr. Leung got PhD from The Chinese University of Hong Kong. He is a certified accountant (FCPA, FCCA), a professional management accountant (FCMA, CGMA, CMA) and a chartered company secretary (FCIS, FCS). He has published and presented more than 30 papers, authored three books and contributed chapters to texts. As Associate Dean (Development) of CPCE, Dr. Leung set up its Campus Sustainability Committee and oversees the implementation of PolyU's campus sustainability policies and guidelines at CPCE.

Artie W. Ng is currently Principal Lecturer and Deputy Director with School of Professional Education & Executive Development at The Hong Kong Polytechnic University (PolyU). Prior to developing his career in business education, Dr. Ng earned professional experience with Coopers & Lybrand and multinational firms in project finance within the independent power sector in Asia Pacific. He obtained his Ph.D. degree from the Adam Smith School of Business at the University of Glasgow, Scotland. Dr. Ng has a research interest in sustainability performance of knowledge-intensive organizations.

Networking the Sustainable Campus Awards: Engaging with the Higher Education Institutions in Developing Countries

Habib M. Alshuwaikhat, Ismaila Rimi Abubakar, Yusuf A. Aina and Bilal Saghir

Abstract

In order to promote sustainability in higher education institutions, different sustainable campus awards have been established to foster best practices and encourage networking among universities. However, the impact and engagement with the awards have not been similar especially between developed and developing countries. This paper reviews the major sustainable campus awards on two fronts; the coverage of different dimensions of campus sustainability and the spatial distribution of award winners. It also examines the impacts of the awards within the local context of Saudi Arabia as a case study of developing countries. The findings show the gap in the aspects covered by these awards and the spatial distribution of winners. This paper concludes with recommendations on how to improve both the engagement and networking of these award bodies with higher education institutions and the coverage of campus sustainability awards in developing countries.

H.M. Alshuwaikhat (✉) · B. Saghir
Department of City and Regional Planning, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia
e-mail: habibms@kfupm.edu.sa

B. Saghir
e-mail: bilal.kfupm@gmail.com

I.R. Abubakar
College of Architecture and Planning, University of Dammam, Dammam 31451, Saudi Arabia
e-mail: irabubakar@uod.edu.sa

Y.A. Aina
Yanbu Industrial College, Yanbu, Saudi Arabia
e-mail: ainay@rcyci.edu.sa

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_7

Keywords
Campus sustainability · Sustainable campus awards · Sustainability network · Developing countries · Saudi arabia

1 Introduction

Sustainability, widely acknowledged as an ultimate goal of human endeavors around the world, is not an end point but a continuous process of ensuring environmental protection and uplifting the quality of life for the present and future generations (Barlett and Chase 2004). It is based on the realization that economic development must incorporate environmental concerns for the protection of ecosystem, as well as social justice to reduce societal problems (Berke and Conroy 2000). Because sustainability is an issue of global concern, several countries have made sustainability as the main focus of their regions, cities, corporations, and institutions (Waheed et al. 2011).

Due to the awareness that campus operations and activities have great impacts on the environment, there are over 31 declarations for sustainability in higher education institutions (HEIs), signed by more than 1400 universities globally (Grindsted 2011). For instance, the United Nations' Decade of Education for Sustainable Development acknowledges stresses the need to integrate sustainability into education systems at all levels. Numerous universities have also voluntarily, or due to pressure from stakeholders, incorporated sustainability into their campus operations and activities, curriculum and learning, research, governance, and community services (Alshuwaikhat and Abubakar 2008).

Universities have key obligations to increase sustainability knowledge and technology, and must aim to develop an environmentally sustainable future on the campus and export these to the society at large (Cortese 1992). Universities are equipped the required capabilities to develop practical and theoretical agenda to play a key part in promoting sustainable living locally and globally. This is because they lead in utilizing education, research, developing policy, community outreach, and information exchange to help create a just and sustainable future (Shriberg 2002). As such, HEIS increasingly implement green/ecological initiatives that integrate sustainability into their curriculum, research, teaching, and campus operation activities, and university stakeholders are continuously supporting the initiatives. However, the green campus initiatives are concentrated in developed countries as their HEIs understand the ecological, fiscal and communal participation benefits, along with enriched student learning that will contribute to a shift to a more sustainable society.

To foster sustainability best practices and encourage networking among HEIs globally, several sustainable campus awards have been established. These include Sustainable Campus Excellence Awards by International Sustainable Campus

Network (ISCN) and Campus Sustainability Leadership Awards by the Association for the Advancement of Sustainability in Higher Education (AASHE). Nonetheless, there is a gap between developed and developing countries in terms of distribution and impacts of the awards, and engagement of the awarding bodies with HEIs. Therefore, this paper aims to; (1) review the existing sustainable campus awards and their coverage of campus sustainability dimensions—teaching, research, operations, governance and community engagement; (2) comparatively analyze the distribution of award winners between developed and developing countries; and (3) examine the impacts of sustainable campus awards in the local context of Saudi Arabia as a case study of developing countries. This paper concludes with recommendations on the need to improve the engagement and networking of these award bodies with institutions from the developing countries.

2 Components of Campus Sustainability

Campus sustainability involves an efficient environmental management system, a prosperous economy based on resource and energy conservation and waste reduction, promoting social justice, and exporting these values to the society (Alshuwaikhat and Abubakar 2008). It is not just about reducing the harmful effect of resource use, or assisting societies to 'make the transition to sustainable lifestyles', it is also about promoting these ideals through teaching, research, community service, collaboration and stewardship (Velazquez et al. 2006). There is a general consensus that the following six dimensions are necessary for fostering campus sustainability (Beringer and Adomssent 2008; Lozano et al. 2014; Lukman and Glavic 2007), and we argue that for any sustainable campus award to be effective, it must cover most of these aspects.

(a) *Teaching and curriculum* transformed to address complex sustainability challenges and prepare the society to recognize and take actions for a sustainable future (Jucker 2011; Vann et al. 2006; Wals 2011). It involves greening the curriculum: a paradigm change in pedagogy that prepares professionals to tackle contemporary global challenges like climate change (Sterling 2004; Wright 2002).
(b) *Research and scholarship* emphasizing on topics such as sustainable buildings, renewable energy, local wisdom and technologies, quality management, sustainable and healthy environment (UNESCO 2004).
(c) *Campus operations* structured on reducing campus' ecological footprint and ensure that operations follow sustainability practices: energy conservation and efficiency practices; sustainable building construction and renovation; green transportation; CO_2 reduction and use of emission control devices; waste reduction and recycling programs, sustainable landscaping; sustainable food programs; green purchasing and investing in environmentally and socially responsible goods (Cole and Wright Cole and Wright 2003; Lozano 2011).

(d) *Institutional framework and management that* ensure sound institutional framework (good governance) and financial sustainability (e.g. income diversification) of their institutions. This enables the institution to cope with challenges such as unstable economic conditions, strains on funding, use of spaces, and requirements for more inclusiveness and resource efficiency (Lozano et al. 2014).
(e) *Community outreach and collaboration* with private and public sectors and community to engagement in activities towards enhancing sustainability and earmark their resources for such. Sustainable campuses also collaborate locally and globally to help solve sustainability problems via community outreach, conferences, training, and student/faculty exchanges (Cole and Wright 2003).
(f) *Sustainability assessment and reporting* for improved understanding of the complex linkages between the natural, social and economic components of a campus, investigating aspects which underpin and undermine environmental sustainability, targets setting, and communicating the outcome of the assessment (Lozano et al. 2014).

3 Higher Education and Campus Sustainability in Saudi Arabia

3.1 Higher Education in Saudi Arabia

Higher education in Saudi Arabia is presently passing through transformation, including ambitious projects of expanding physical structures and infrastructure, creating new programs, human resources development through overseas study scholarships, recruitment of domestic and expatriate faculty, and educational policies and strategic plans (Abubakar et al. 2016). These projects and programs, aim to meet the mounting demands for higher education caused by increasing the population of students graduating from high schools, indicate the country's commitment to higher education, and its significance in building human capital and educating future decision makers on how to help built a sustainable society.

Similarly, Saudi national development plans recommended constructing new universities across all regions and provinces based on population density. As such, the number of universities has increased more than three times in the last quarter of the century. There were seven public universities in 1990, eight in 2000 and now twenty-seven. There are also eight private universities spread across the kingdom (Abubakar et al. 2016, p. 4).

Higher education is the responsibility of the Ministry of Education, which earmarks substantial budget to developing HEIs. According to Abubakar et al. (2016),

from 2005 to 2009, the budget for higher education has increased more than three times from US$ 2.67 billion to US$ 8.53 billion. Although universities are under the Ministry, they are independent in financial, administrative and academic issues.

Considering these huge ongoing investments in universities, it is vital to appraise their current sustainability practices and explore how sustainable campus awards can help promote more sustainability initiatives the universities.

3.2 Campus Sustainability in Saudi Arabia

Saudi Arabian universities, like in many other developing countries, are still outside the global network of major campus sustainability actors. However, the universities are now trying to learn from best practices of incorporating sustainability into mainstream operations of campus management and engage with international networks of sustainable campuses. Except in two cases, little is known about the status of campus sustainability in Saudi Arabia.

First, King Abdullah University of Science and Technology (KAUST) is the greenest university in the country. Built with an emphasis on sustainable practice, the University buildings have been built with 75 % recycled materials, utilize natural light and ventilation and are water- and electricity- efficient. In 2010, the main University academic building got a Platinum rating on the Leadership in Energy and Environmental Design (LEED) scale. The campus also has implemented waste composting and recycling program, in addition to fostering research in renewal energy and environment (http://www.kaust.edu.sa/green-campus-sustainable-development.html [27 January 2016]).

Second, University of Dammam has also established a Deanship of Sustainable Development for improving the campus environmental sustainability. A study based on students' evaluation, reported that the University main campus has implemented some garbage recycling and landscaping efforts, and there are few initiatives on green building and energy and water conservation (Abubakar et al. 2016). Similarly, the curriculum and students' projects in the Bachelor of Urban and Regional Planning program have been evaluated based on US Building Council's ten smart growth principles. Based on the review of the syllabi of courses in the Bachelor curriculum, the study found that only about16 % of the total contact hours in the program are related to the smart growth principles (Abubakar 2013). The author concluded that students seem to learn about smart growth and sustainable development through the final-year projects more than from the taught courses.

This section has shown that there are few initiatives by Saudi universities towards promoting sustainability. Therefore, the universities should learn and implement international best practices, and engage with international organizations that acknowledge incorporating sustainability into the academia.

4 Sustainability Awards for Campuses: Coverage and Spatial Distribution

The different national and international platforms for campus sustainability awards recognize the efforts of university campuses in promoting campus sustainability. Based on their scope and scale, these sustainability award programs can be classified into three broad categories:

1. University level award programs
2. National and regional level award programs
3. International awards programs

4.1 University Level Award Programs

University level award programs acknowledge the contributions of departments and individuals towards sustainability. Based on Google search, 15 universities were found to give local sustainability awards in at least three of the six campus sustainability dimensions (Table 1). For example, the University of Winnipeg has established the annual Campus Sustainability Recognition Award to acknowledge the contributions of its faculty members or staff to campus sustainability efforts. Also, University of Colorado's annual campus sustainability award program rewards commitment to reducing the burden of the campus on the environment. Similarly, Cornell University Partners in Sustainability Award acknowledges the valuable contributions of staff, students, and regional partners in sustainable transformation of the campus.

The award coverage was based on the six campus sustainability dimensions mentioned in Sect. 2. However, our analyses of these local ward programs were based on five campus sustainability dimensions (teaching and curriculum, research and scholarship, campus operations, institutional framework and campus management, and community outreach and collaboration), given that assessment and reporting is done by universities themselves. The table shows that only six universities cover all the five dimensions and the awarding universities are concentrated in USA, Canada, and the UK. This can be attributed to higher environmental awareness and university financing in the developed countries in comparison with developing countries of Asia, Latin America and Africa (where only one South African university awards campus sustainability initiatives).

4.2 National and Regional Level Award Programs

There are many national and regional associations, organizations and governments that recognize and reward campus sustainability efforts. Similar to the local award programs, this category of awards is also more implemented in the West than in

Table 1 University level award programs (compiled from the websites of the universities [14 February 2016])

Name of university	Sustainability dimensions covered by the award
University of Winnipeg, Canada http://www.uwinnipeg.ca/awards-distinctions/sustainability/index.html	Awards have been given based on contributions in all the five dimensions
University of Colorado, USA http://www.colorado.edu/ecenter/greening-cu/campus-sustainability-awards	All five dimensions but emphasis is on campus operations, community outreach, and institutional framework
Cornell University, USA http://www.sustainablecampus.cornell.edu/initiatives/cornell-university-partners-in-sustainability-award	All five dimensions
The University of Edinburgh, UK http://www.ed.ac.uk/about/sustainability/about/programmes/awards	Campus operations, institutional framework and community outreach
Swansea University, UK http://www.swansea.ac.uk/sustainability/sustainabilityaward/	Teaching and curriculum (informal curricula), campus operations (practical sustainability, employability skill) and community outreach
Newcastle University, UK http://www.ncl.ac.uk/sustainable-campus/involved/impact/awards.htm	Campus operations, institutional framework and management, community outreach
The University of Canterbury, New Zealand http://www.sustain.canterbury.ac.nz/awards.shtml	2013 awards have been given based on contributions in research and scholarship, and campus operations
Simon Fraser University, Canada http://www.sfu.ca/sustainability/engagement/get-involved/leadership-in-sustainability-awards.html	Campus operations, institutional framework, and community outreach
University of Alberta, Canada http://www.sustainability.ualberta.ca/GetInvolved/Recognition.aspx	Teaching and curriculum, campus operations, and community outreach
Berkeley University of California, USA http://sustainability.berkeley.edu/cacs/cacs-sustainability-awards	All five dimensions
University of Pittsburgh, USA http://www.sustainable.pitt.edu/content/pitt-sustainability-awards	All five dimensions
University of Utah, USA http://sustainability.utah.edu/awards.php	All five dimensions
Harvard University, USA http://green.harvard.edu/campaign/harvard-green-carpet-awards	Campus operations, institutional framework, and community outreach
University of Kentucky, USA http://oepos.ca.uky.edu/uk_sustainability_awards	Campus operations, institutional framework and community outreach
University of Cape Town, South Africa http://www.greening.uct.ac.za/gci/awards/	Research and scholarship, campus operations, institutional framework and community outreach

developing countries. For example, the Environmental Association for Universities and Colleges, a non-profit charity with a membership of more than 215 HEIs in the UK, established Green Gown Awards to recognize exceptional sustainability initiatives undertaken by HEIs (http://www.eauc.org.uk/about1 [15 February 2016]).

Similarly, the National Association of College and University Food Services, with a membership of about 550 North American HEIs, recognizes on an annual basis the efforts of member institutions on sustainable campus dining operations (https://www.nacufs.org/about-nacufs-overview [15 February 2016]). Likewise, APPA: Leadership in Educational Facilities, an association with over 10,000 professionals of education facilities from 1300 educational institutions, awards universities for their sustainable practices and leadership in campus facilities management and operations such as energy, utility use, planning and construction (http://www.appa.org/membershipawards/index.cfm [15 February 2016]). Also, the Illinois Governor's Sustainability Award, founded in 1987, recognizes public and private organizations that are innovative in sustainability and are committed to environmental, social and economic sustainability.

Other national or regional awards include Sustainable Energy Association's Award (UK), Tree Campus USA, Carolina Recycling Association's awards (USA), and National ACEC Honor Award (USA), the National Association of Collegiate Directors of Athletics Sustainability Award (USA), the Australasian Campuses Towards Sustainability awards (Australia), Premier's Sustainability Awards (Australia), and Africa's Greenest Campus Award (South Africa). The coverage of the national and regional awards is similar to the spatial and sustainability component coverage of the university level awards. They are mainly concentrated in North America and the UK and they cover the sustainability components in varying forms.

4.3 International Award Programs

The international awards for campus sustainability are few, but they cover wide categories of sustainability practices such as research, outreach, campus operations, community outreach and financial management. Apart from their practical coverage and membership around the globe, these awards vary in their recognition of campus sustainability innovations and practices by students, staff, faculty and associations in the academia. This section analyzes two major international award programs.

(a) *International Sustainable Campus Network* (ISCN) *Campus Excellence Awards*

The Campus Excellence Awards by ISCN acknowledge prominent sustainability projects and practices by university campuses that demonstrate notable practices through leadership, effectiveness, creativity, and outstanding performance in the following areas:

- Buildings,
- Campus operations,
- Integration, and
- Student outreach/leadership.

Since the inception of ISCN awards program in 2009, more than 180 nominations from institutions all over the world were submitted. Figure 1 shows the spatial distribution of member institutions from different countries. The distribution of the membership indicated that they are more concentrated in Europe followed by North America and then Asia. While there are only four universities in South America that are ISCN members, in Africa only South Africa and Nigeria have institutions that are members. There are also two members from Oceania.

The campuses that won the ISCN awards from different parts of the world are presented in Table 2. Since 2009, twenty-five awards were given out of which European and North American universities got 13 (52 %) and 7 (28 %) awards

Fig. 1 Spatial distribution of ISCN members (http://www.international-sustainable-campus-network.org/membership/iscn-member-directory [02 February 2016])

Table 2 Distribution of ICSN sustainable campus award winners by continent, 2009–2015 (compiled from www.international-sustainable-campus-network.org/awards [14 February 2016])

Continents	2009	2010	2011	2012	2013	2014	2015
North America	0	0	2	2	1	1	1
Europe	1	3	0	2	3	2	2
Asia	0	1	0	1	1	1	1
Oceania	1	0	0	0	0	0	0
South America	0	0	0	0	0	0	0
Africa	0	0	0	0	0	0	0
Total	2	4	2	5	5	4	4

respectively. Asian universities trail behind these continents with 5 (20 %) awards. In 2010, KAUST from Saudi Arabia won the award under construction category and it is still the only campus that won any ISCN awards from the Middle East. For the whole seven years under review, no any university from the whole of Africa, South America and Oceania got any award. It is evident from Table 2 that developing countries universities are lagging behind in terms of receiving the ICSN campus excellence awards.

(b) *Association for the Advancement of Sustainability in Higher Education (AASHE)*

This is a non-profit organization with over 900 member institutions with a mission of supporting faculty members, staff, and administrators of HEIs around the world to become efficient agents of bringing change related to sustainability innovation in their institutions. It also aims to motivate students as the leaders of tomorrow and equip them with necessary skills, knowledge and professional development to resolve sustainability issues.

KAUST is the only member university of AASHE from Saudi Arabia. Other universities from Arab countries include American University of Cairo, Egypt and Qatar foundation. But most of the member institutions are from Australia, Canada, Greece, Guatemala, Hong Kong, Korea, Mexico, New Zealand, South Africa, Switzerland, United Kingdom and the USA. Membership benefit includes events discount, publicity, and access to various data resources. AASHE offers two types of membership:

(i) Institutional membership; and
(ii) Associate membership, which is further categorized into: (a) institutions in North America; and (b) institutions outside North America

It evident from Table 3 that the distribution of AASHE awards is concentrated in North America. The absence of institution from countries outside North America shows the lopsided nature of the distribution. Despite having more than 900 members globally, all the 73 awards were won by HEIS in North America, and hence, the representation of the rest of the world is very weak.

Table 3 Distribution of AASHE campus sustainability leadership awards by continent 2006–2015 (compiled from: www.aashe.org/about/aashe-awards5 [02 February 2016])

Continents	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
North America	5	7	11	8	5	6	9	7	6	9
Outside North America	0	0	0	0	0	0	0	0	0	0
Total	5	7	11	8	5	6	9	7	6	9

5 Impacts of Sustainable Campus Awards on HEIs in Developing Countries – Saudi Arabia as a Case Study

In Saudi Arabia, as in most developing countries, there is the very limited participation of HEIs in sustainability award competitions, both local and international. In Saudi Arabia, KAUST is the only member of AASHE and the only winner of ISCN award (Table 4). It also won the American Institute of Architects' Committee on the Environment (AIA/COTE) Top Ten award in 1997. In addition, KAUST has been participating in the Dow Sustainability Innovation Student Challenge Award

Table 4 Local and international sustainability awards participated by Saudi universities (compiled from the websites of sponsors and universities [14 February 2016])

Award	Focus	Sponsor	Founded	Winners
Sustainable Campus Excellence Awards http://www.international-sustainable-campus-network.org/awards	Outstanding campus sustainability projects, practices, and performance	ISCN	2009	KAUST 2010: Construction category
AIA/COTE Top Ten Award http://www.aiatopten.org/	University campus/building projects that promote high environmental performance through architectural solutions	AIA	1997	KAUST 2010
Sustainability Innovation Student Challenge Award http://www.dow.com/en-us/science-and-sustainability/collaborations/academic-collaborations/dow-sisca/	Students, professor, who are committed to sustainability innovation. Cash prizes are awarded to winners	Dow	2009	KAUST 2014: two students' awards
Unilever KSA Environmental Research Award https://www.unileverme.com/news/news-and-features/2015/unilever-ksa.html	Research projects on waste management, water reduction and energy reduction	Unilever KSA	2015	Just started

(Dow SISCA awards). For example, a PhD students won the first-place in the 2014 Dow SISCA awards based on a project for harvesting energy from waste heat using Nanoscale Thermoelectrics (http://www.kaust.edu.sa/latest-stories/dow-sisca-awards.html [13 March 2016]). The participation of KAUST in the awards has boosted the institution's commitment to campus sustainability. As an award holder and LEED certified institution, KAUST has adopted initiatives and programs to maintain the green campus status. These achievements make KAUST the pacesetter and the leading university in campus greening and winning sustainability awards in the country.

The other HEIS in the Kingdom can be able to achieve green campus if they are encouraged to follow the path of KAUST. A network for collaboration between KAUST and other HEIs in the Kingdom should be established so that the institutions can learn from KAUST's experience in campus sustainability. The Saudi Environmental Society (SENS), a non-governmental organization, is working on raising awareness about the environment in Saudi universities and also collaborating with the universities to establish programs related to the environment and sustainability. The society also plans to establish environment and sustainability awards for Saudi universities. In 2015, the Unilever KSA Environmental Research Award was established through collaboration between Unilever and SENS.

Apart from the awards mentioned, there are other environmental and sustainability awards that are not specifically for HEIs but universities can participate in them (Table 5). The Kingdom of Saudi Arabia Award for Environmental Management, the Prince Sultan Bin Abdulaziz International Prize for Water and the CSR Saudi Arabia awards are some of the awards that universities and their researchers can participate in them.

Since 1999, there are opportunities for Saudi universities to compete in awards related to campus sustainability (Tables 4 and 5). But authors' search of the websites of the universities could not find any evidence of participation or winning awards, except in the case of KAUST. The low level of participations in awards by Saudi universities is partly due to lack of awareness and low priority accorded to the issue. Even though, benefits of participation in campus sustainability awards include networking, collaboration, information sharing, and professional development to help advance sustainability at campuses.

However, there is an on-going initiative entitled National Scheme on Sustainability in Saudi Universities by King Fahd University of Petroleum and Minerals and sponsored by the Ministry of Education to promote sustainability in Saudi universities (Alshuwaikhat 2016). The initiative will introduce the concept of sustainability in higher education institutions in the Kingdom and establish sustainability units in Saudi universities and hence encourage the commence award on campus sustainability.

Table 5 Awards relevant to campus sustainability in Saudi Arabia (compiled from websites of sponsors and collaborators [14 February 2016])

Award	Focus	Sponsor	Founded	Beneficiary
Kingdom of Saudi Arabia Award for Environmental Management http://www.arado.org/Content.aspx?s2=1066	Sustainable development and environmental governance.	Presidency of Meteorology and Environment, Saudi Arabia in cooperation with Arab Organization for Administrative Development	2004	Individuals and organizations
Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW) http://www.psipw.org/	Sustainable water supply and water scarcity mitigation	Prince Sultan Research Center for Environment, Water and Desert	2002	Researchers, inventors and research organizations
GCC Environment Forum Awards http://www.gccenvironmentforum.com/awards/	Excellence in promoting environmental and sustainable causes.	Presidency of Meteorology and Environment	2010	Individuals and organizations
CSR Saudi Arabia awards—Environmental Sustainability Award http://www.csrsummitsaudi.com/CSR-Awards/About-The-Awards/	Environmental protection preservation and initiatives	Boeing	2014	Mainly organizations

6 Conclusion

This paper has reviewed the spatial distribution of campus sustainability awards at university, national/regional and international levels. Both the awards and the winners are predominantly from the developed world. One of the possible reasons is the awareness and the higher priority agenda for making campuses sustainable among the developed countries. Similarly, the membership of international associations that award campus sustainability initiatives is more dominant in Europe and North America, and Australia to some extent. The developing countries are still behind in membership as well as in competing for awards.

One of the ways to bridge the gap is for the international awarding associations to reconsider the criteria of competing in awards to make it more flexible for wider coverage and participation around the globe. The starting point is to increase the coverage of their membership to include more institutions from the developing countries. In addition, it is important to encourage more institutions from

developing countries to compete for annual awards. Indeed, special awards can be introduced for new and upcoming members as a means of encouraging them. Initiatives such as the United Nations Higher Education Sustainability Initiative, which has wide membership coverage (about 300 universities), can introduce awards to encourage members to uphold the principles of campus sustainability and promote best practices. There is also the need for the governments and private proprietors in developing countries to enlist their institutions in these awards institutions which would encourage them to adopt sustainability practices and widen their networks on international platforms.

The Saudi Universities have a huge potential to compete for local and international awards for campus sustainability. While Saudi Universities are coming in the list of top tier universities of the world by improving their international rankings every year, they are lagging behind in terms of campus sustainability awards. There is thus the need to utilize part of huge investments in the educations sector to campus sustainability. It is also important for Saudi Universities to be engaged with the institutions that recognize campus sustainability efforts around the globe. Considering that the national economy is based on oil, sustainability practices are a vital element that will certainly add value and efficiency to resource consumption. In this context, Saudi institutions need to be active, not only in getting the membership of such institutions and professional organizations, but also in implementing campus sustainability initiatives, based on which they can seek for local and international recognitions and awards.

Acknowledgments The authors acknowledge the support of the National Plan for Science, Technology and Innovation (MAARIFAH), King Abdulaziz City for Science and Technology through the Science & Technology Unit at King Fahd University of Petroleum and Minerals, Saudi Arabia (Award number: 14-BUI109-04).

References

Abubakar, I. R. (2013). Role of higher institutions of learning in promoting smart growth in developing countries: University of Dammam as a case study. *Proceedings of the 8th International Forum on Knowledge Assets Dynamics: "Smart Growth: Organizations, Cities and Communities"* (pp. 591–608). Croatia: Zagreb.

Abubakar, I. R., Al-Shihri, F. S., & Ahmed, S. M. (2016). Students' assessment of campus sustainability at the University of Dammam. *Saudi Arabia. Sustainability, 8*(1), 59.

Alshuwaikhat, H. M. (2016). The national scheme on sustainability in Saudi Universities—An unpublished preliminary research report submitted to the Ministry of Education through King Fahd University of Petroleum and Minerals.

Alshuwaikhat, H. M., & Abubakar, I. (2008). An integrated approach to achieving campus sustainability: Assessment of the current campus environmental management practices. *Journal of Cleaner Production, 16*(16), 1777–1785.

Barlett, P. F., & Chase, G. W. (2004). *Sustainability on campus: Stories and strategies for change*. MA, US: MIT Press.

Beringer, A., & Adomssent, M. (2008). Sustainable university research and development: Inspecting sustainability in higher education research. *Environmental Education Research, 14* (6), 607–623.

Berke, P. R., & Conroy, M. M. (2000). Are we planning for sustainable development? An evaluation of 30 comprehensive plans. *Journal of the American Planning Association, 66*(1), 21–33.

Cole, L., & Wright, T. (2003). *Assessing sustainability on Canadian University campuses: Development of a campus sustainability assessment framework*. Canada: Royal Roads University.

Cortese, A. D. (1992). Education for an environmentally sustainable future: A priority for environmental protection. *Environmental Science and Technology, 8*, 1108–1111.

Grindsted, T. S. (2011). Sustainable universities: From declarations on sustainability in higher education to national law. *Environmental Economics, 2*(2), 29–36.

Jucker, R. (2011). ESD between systemic change and Bureaucratic obfuscation some reflections on environmental education and education for sustainable development in Switzerland. *Journal of Education for Sustainable Development, 5*(1), 39–60.

Lozano, R. (2011). The state of sustainability reporting in universities. *International Journal of Sustainability in Higher Education, 12*(1), 67–78.

Lozano, R., Ceulemans, K., Alonso-Almeida, M., Huisingh, D., Lozano, F. J., Waas, T., et al. (2014). A review of commitment and implementation of sustainable development in higher education: Results from a worldwide survey. *Journal of Cleaner Production, 108*, 1–18.

Lukman, R., & Glavič, P. (2007). What are the key elements of a sustainable university? *Clean Technologies and Environmental Policy, 9*(2), 103–114.

Shriberg, M. (2002). Toward sustainable management: The University of Michigan housing division's approach. *Journal of Cleaner Production, 10*(1), 41–45.

Sterling, S. (2004) Higher education, sustainability, and the role of systemic learning. In *Higher education and the challenge of sustainability* (pp. 49–70). Springer: The Netherlands.

UNESCO. (2004). *United nations decade of education for sustainable development 2004–2015*. Paris: Draft International Implementation Scheme, UNESCO.

Velazquez, L., Munguia, N., Platt, A., & Tadde, J. (2006). Sustainable university: What can be the matter? *Journal of Cleaner Production, 14*(9), 810–819.

Vann, J., Pacheco, P., & Motloch, J. (2006). Cross-cultural education for sustainability: Development of an introduction to sustainability course. *Journal of Cleaner Production, 14*(9), 900–905.

Waheed, B., Khan, F., & Veitch, B. (2011). Developing a quantitative tool for sustainability assessment of HEIs. *International Journal of Sustainability in Higher Education, 12*(4), 355–368.

Wals, A. E. (2011). Learning our way to sustainability. *Journal of Education for Sustainable Development, 5*(2), 177–186.

Wright, T. S. (2002). Definitions and frameworks for environmental sustainability in higher education. *Higher Education Policy, 15*(2), 105–120.

Sustainability Skills: The Case of a Portuguese University

Thiago Antonio Beuron, Lucas Veiga Ávila, Luciana Londero Brandli, Filipe Jorge Ribeiro de Almeida, Lúcia Rejane da Rosa Gama Madruga and Eduardo Jorge Gonçalves Barata

Abstract

Based on the state of the art on universities and sustainability, an attempt was made to understand the development of a Portuguese university on the perspective of sustainability, by analyzing the necessary skills for such sustainability. The design used for this research was the case study design. The data collection occurred between September and November 2014, and a data collection protocol elaborated from the theory on sustainability in universities was used. Through observations, interview and analysis of documents as evidence sources, the most expressive results highlight that the University of Coimbra—UC uses sustainability concepts that go beyond teaching and learning. The institution aims to develop, through programs, contests to gather ideas from students and business consultancies, a philosophy that would emerge

T.A. Beuron (✉)
Federal University of Pampa, Quaraí, Brazil
e-mail: tbeuron@gmail.com

L.V. Ávila · L.R. da Rosa Gama Madruga
Federal University of Santa Maria, Santa Maria, Brazil
e-mail: admlucasveiga@gmail.com

L.R. da Rosa Gama Madruga
e-mail: luciagm@ufsm.br

L.L. Brandli
University of Passo Fundo, Passo Fundo, Brazil
e-mail: brandli@upf.br

F.J.R. de Almeida · E.J.G. Barata
Faculty of Economics, University of Coimbra, Coimbra, Portugal
e-mail: falmeida@fe.uc.pt

E.J.G. Barata
e-mail: ebarata@fe.uc.pt

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_8

from the sustainability skills inside the campus, curriculum and community. Through the environmental management of the campus, UC promotes energy savings, preservation of resources, waste reduction, preservation of the property, gas and water as to the energy efficiency plan, and the creation of new courses for sustainable development. It is observed that the university has the efficient sustainability skills as to the analyzed dimensions, and they were monitored as to its goals and programs. With lower emphasis, due to the secular characteristics, the sustainability actions occur on the structures that require alternatives to meet new sustainability concepts, which have been introduced into green universities.

Keywords
Skills · Sustainability skills · Universities · Sustainability

1 Introduction

The Decade of Education for Sustainable Development (2005–2014) was suggested to promote a social momentum that would engage educators in the task of make people aware on the planetary emergency situation and qualify them for the decision-making processes in order to stop environmental degradation. In general, the changes to the curriculums, teaching practices and research do not yet meet the demands of the global-scale problems, that require holistic approaches (Vilches 2012). Universities may be seen as laboratories to practice sustainability initiatives (Thomashow 2014).

As a complex type of organization, universities are continuously demanded to contribute with the discussion on sustainability, mainly since they are an educational environment, not only a productive one, such as industries and other sectors. Through universities, it is expected to promote new collective postures that depend on a change of awareness, new knowledge, and balance and dialogue with society.

The consensus indicated by UNESCO (2014) is that the key questions to reach the sustainable development go through teaching and learning. Themes such as climate change, reduction of the risk of disasters, sustainable lifestyles, biodiversity or poverty reduction are characterized by uncertainty, complexity and systemic interconnection. As such, they demand more participative teaching and learning methods, such as critical thinking, through which it is possible to work with collaborative decision-making scenarios, qualifying the academic communities for the sustainability context.

From a report elaborated by a committee of experts from around the world, the answer to the Decade of Education for Sustainable Development is the need for innovation in education, in order to promote it as a tool for society to move toward sustainability (UNESCO 2014). This report suggests that the process of creation and reorientation of sustainable development policies, programs and plans occurs in the Member States in a rather unequal manner.

The final report of UNESCO (2014) also discusses the need for the development of skills and abilities on students in order to promote the value of sustainability for businesses and to work focused on a global economy, which is more inclusive and sustainable, namely on the level of MBAs, post-graduation courses and short-term courses for executives. The research results emphasize the gap between the sustainability perspectives that are taught at schools and that are required on the market by companies, indicating a need to further establish a clear set of skills to be used in companies, in order to reinforce the skills demanded by the context (UNESCO 2014).

The issue of sustainability in Higher Education Institutions has been marked by a series of events, statements and resolutions that try to comprehend variables that need to be included in the daily life of the campus. This study explores the way in which a Portuguese University develops the perspective of sustainability, by analyzing the essential skills for sustainability that make this organization stand out. Specifically, the analysis and reflection focus on how the University of Coimbra contributes to build sustainability skills, which are the essential skills that make this organization stand out, or which are the representative skills in the campus, curriculum and the community.

Initially, the article approaches the literature on sustainability skills, describes the method that works as the basis for research, shows the case and the evidence found and provides the conclusions.

2 Sustainability Skills

Up to the end of the Middle Age, the term *skills* referred to the judicial area, which used this expression to refer to the ability of some institution or individual to appreciate and/or judge certain issues. From that, the concept was broadened as the social acknowledgement on the capacity of an individual to speak in relation to any subject. Then, it was used in more general terms to qualify any individual with the ability to conduct a certain work (Isambert-Jamati 1997; Brandão and Guimarães 2001).

On the organizational theory, skills are considered fundamental for the competition among organizations, and they are seen as the positive result of the efforts of individuals and organizations in relation to individual and/or organizational objectives. According to Draganidis and Mentzas (2006), this result is seen as the combination of knowledge, behaviors and abilities that confer someone an efficiency potential to perform a certain task.

The organizational skill integrates specific functional and technological abilities in larger sets of abilities, such as the creation and management of extremely complex products or services that are possible by understanding the core of the phenomena. It is an iterative and progressive set of understandings and skills by the employees, and it occurs within the organizational structure, and not individually (Edgar and Lockwood 2008).

The notion of essential skills is also highlighted, and they are defined as skills that offer a competitive edge to the organization through the execution of this skill, that is, they were built throughout time and are not easily imitated (Prahalad and Hamel 1990). Drejer and Riis (1999) point out that the skill comprehends four generic elements: technology, human beings, organization and culture.

Draganidis and Mentzas (2006) show the lifecycle of a skill: mapping, diagnosis, development and monitoring. These four stages search for continuous improvement and the development of new skills. The first phase surveys the necessary skills for the organization. The second phase analyzes the current situation of the skills and the individual proficiency. The development includes programming activities, and increasing the number and proficiency level of the skills that the employees must have. And, finally, monitoring promotes the continuous analysis of the results obtained by the other phases.

In addition to the organizational skills (Prahalad and Hamel 1990), the literature shows work-related skills (Zarifian 2001), or even skills of people in a certain organizational context (Dutra et al. 2000). In that sense, an important division is between human skills (related to the individual or the team) and the organizational skills (related to the organization as a whole) (Prahalad and Hamel 1990).

Wals (2014) analyzed the results of a report focusing on teaching and learning in all regions (Asia-Pacific, Africa, Europe, Arab region, Latin and North America), searching for a wide range of informers, such as administrators, researchers, politicians and other professionals on global, regional and local levels. The reports indicate methods and strategies used by different universities in order to become more sustainable within their contexts, in the search to develop the most specific skill for sustainability.

Universities have also created specific Chairs that approach international entities, such as UNESCO, discussing in depth the skills for sustainable development and sustainability in courses, professional development programs, activities to raise awareness in the community and continuing education for all agents of change, even the ones that intend to develop their careers outside the structure of Higher Education Institutions (Wals 2014).

Higher Education Institutions have broadened their responsibilities to introduce new ways to dialogue with society regarding sustainability. Wals (2014) highlights some of the learning methods used: the interaction between multi-stakeholders; the use of competing perspectives; diversity management according to its different aspects; inter- and transdisciplinarity; problem-based learning; value-based learning, and experiential and social learning.

A central principle is sustainable consumption in higher education, both within the campus and curriculum, and in the actions developed in the community. Sustainable consumption is understood as a consumption method in which the individuals are able to meet their main needs, maintaining ecological and socioeconomic mechanisms that are necessary for the human development and that constitute an adequate lifestyle, extrapolating the short-term perspective (Dobson 2007). Considering Higher Education for Sustainable Consumption—HESC—means to show the severity of consumption as a source of environmental and social

impact, in addition to incorporate the notion of individual and collective responsibility (Clark 2007).

By showing the case of the University of Bordeaux, in France, Gombert-Courvoisier et al. (2014) state that, in order to reach HESC, some pedagogical principles are necessary in order for the education of students to contemplate the solution o factual and complex problems, knowingly: considering human ecology as a pedagogical approach; treat the consumption system as a whole, considering the ecological impacts of production, supply, use and elimination methods; enable students to deal with uncertainty, with an heterogeneous audience; promote collaborative learning based on diversity; and approach complexity through interdisciplinarity. By adopting these principles, it is possible to contribute to learn key skills for sustainability, which may be seen as multifunctional individual skills independent from the context and that are fundamental to reach social and sustainability goals (Rychen 2003).

At least three approaches have been considered in relation to learning contexts: self-learning, in which the individuals build their knowledge base by themselves; social or collaborative learning, in which interaction becomes essential; and guided learning to solve actual sustainability problems (Brundiers et al. 2010; Burandt and Barth 2010; Yasin and Rahman 2011).

Developing the necessary skills for sustainability is a method of collective construction; the learning environment must offer the students incentives to implement solutions and make decisions regarding complex ecological problems, associated with changes in the consumption methods and global problems. These learning processes depend on people, skills and availability of support (Barth and Rieckmann 2012).

From the skills indicated by the theory, required within the context of sustainability, Fig. 1 sums up the skills that will be considered on this study: Thinking in a prospective manner, dealing with uncertainties; Working on a multidisciplinary environment; Searching for interconnections, independence and partnerships; Understanding transcultural cooperation for more flexible perspectives; Participation capacity; Planning and implementation capacity; Empathy, being kind and solidary; Personal and group motivation; and Understanding different behaviors and cultural perspectives (Barth et al. 2007; Wals 2014; Gombert-Courvoisier et al. 2014).

3 Methods

This study is classified as a case study (Yin 2015) in the University of Coimbra, Portugal, conducted from September to November 2014.

The case study was chosen as the design since it allows understanding the perspective of sustainability in the studied institution in a holistic manner. This was adequate since the focus of the analysis is a complex and contemporary social phenomenon, which requires an empirical approach, and it involves elements and

CAMPUS
Below are the initiatives of the Campus of University of Coimbra: **- Energy for Sustainability - EfS** is an initiative from UC, gathering professors from the different Schools, with vast experience in teaching, investigation, technology transfer and consultancy in themes connected specifically to energy and sustainable development. This initiative aims to transfer knowledge to society, through the interaction with political decisions, managers and responsible technicians in several activity sectors. In order to maintain a strong connection with the actual problems of society, the initiative maintains contact with companies and other organizations that integrate its External Advisement and Standardization Committee (CEAA); - The University of Coimbra, through the EfS initiative, is a member of the **European Platform of Universities Engaged in Energy Research, Education and Training** (EPUE). EPUE includes universities from all over Europe with investigation and teaching abilities in the area of energy, covering basic sciences, engineering, life and health sciences, economy, social sciences and humanities; - Within the scope of this initiative, the University of Coimbra offers advanced qualification programs that include a Specialization course, a Master's Degree course and a Doctorate course, the latter in combination with the **MIT Program (Portugal);** **- "A EfS Wave at UC Qualification" Contest –** The objective of the contest is to promote and encourage the interest of students for themes related to the EfS Initiative from UC within the scope of the Sustainable Campus Program; **- EfS Initiative Photography Contest -** The objective of the EfS Photography Contest is to select images to be used in the different supports to promote the Energy for Sustainability Initiative from the University of Coimbra; - The *Energy for Sustainability* Initiative gathers professor and investigators from several investigation units and schools of University of Coimbra, as well as autonomous I&D units to which it is associated. This page highlights the institutions with the most representativeness for planning and conducting the activities from the *Energy for Sustainability* Initiative; - The university stands out due to the multidisciplinarity of Units and Schools that promote sustainability.

Fig. 1 Campus initiatives for sustainability at University of Coimbra. *Source* GREEN_UC. See more at: http://www.uc.pt/efs/green_uc

variables in relation to which it is not possible to have the necessary control using other procedures. The single case study was adopted to explore a situation in which the evaluated intervention did not have a single and clear set of results, and also because it allowed different theoretical branches to be used (Yin 2015).

In order to build the data collection protocol, observation and interview scripts were elaborated from the emerging theory on the subject. The interview was conducted with the Vice-Dean, responsible for the Strategic Planning of the Institution. The data collection occurred between September and November, 2014. The non-participant observation was chosen, in which the researcher conducts an impartial observation, and they do not participate as a member of the observe group. The analysis of documents and the institutional website was also considered as source of evidence.

In that case, the dimensions highlighted by Müller-Christ (2015) were used: campus, curriculum and community. The analysis process used as reference the Content Analysis method, defined by Bardin (2011) as a technique to read and interpret the content of any material from a verbal or non-verbal communication. This author highlights that content analysis is an investigation technique whose purpose is the objective, systemic and quantitative description of the manifested content of the communication.

4 Presentation and Analysis of Results

It is important to highlight the responsibility of universities as responsibility catalyzers for society, namely because the presence of the institutions offers several benefits for companies and the local community.

Researches on the role of universities and their potential contributions for sustainable development and sustainability refer to three fundamental areas: campus, curriculum and community. The University is no longer the castrating and moralizing environment; rather, it encompasses dimensions related to society welfare, beyond the responsibilities with the campus operations, creating models that may be transferred to the community (Müller-Christ 2015).

From these three dimensions, an attempt was made to identify on the speech of the UC managers some contributions that would characterize the studied institution. Results are shown in Fig. 1.

The evidence exposed on campus as one of the differentials of the institution, from which the academic and external community have the possibility to experience a sustainability-oriented culture.

The events, contests and the European Platform of Universities Engaged in Energy Research, Education and Training (EPUE) are one of the main highlights together with the several multidisciplinary departments, focused on research in graduation and post-graduation. For Thomashow (2014), the campus is the adequate location to explore, build and practice this ethos. Elements established by the author are seen on the campus programs, such as EfS for qualification, photography contests and initiatives driven toward energy for sustainability.

Wals (2014) highlights that Higher Education Institutions have broadened their responsibilities, including new methods to dialogue with society, oriented toward learning. The author mentions the need to create new systems based on new principles, among them, sustainable consumption in higher education. The issue of water and energy consumption and the rational use of paper printing are observed on the examples mentioned on the interviews.

Below are the results for the Curriculum for sustainability initiatives at the University of Coimbra (Fig. 2).

Within the curriculum dimension, it may be observed that UC has evidence since its first Doctorate thesis in 1985 on energy efficiency; later on, in 1990, the first Master's Degree discipline on energy management was incorporated. It is noteworthy that the curriculum at UC advanced with interdisciplinary characteristics, and it is integrated and based on values, associated to participative teaching and learning methods, being able to allow critical thinking (Wals 2014) (Fig. 3).

When discussing the participation of the community on the activities of the campus, Du et al. (2013) highlight the need to create learning communities, to open the doors of the university in order to create an interaction with national, regional and local agents. The results of this aspect reveal that the University of Coimbra has

CURRICULUM
UC and Sustainability - The first Doctorate thesis in Portugal on energy efficiency and energy management was completed at the University of Coimbra (Department of Electrotechnical Engineering) in 1985; - The first discipline on energy management was created in 1990 within the scope of a Master's Degree course. Before that, however, since 1979 work was being conducted at the University of Coimbra in the areas of energy efficiency and renewable energy. - For almost three decades, UC was the home for a large number of Master's Degree and Doctorate dissertations, on themes such as: Energy efficiency and energy management (whether on thermal energy or electrical energy, in buildings and the industry); Sustainable buildings; Regional and urban planning; Electricity production planning; Co-generation; Demand side management (DSM); Transformation of energy markets; Energy network management; Energy-environment-economy interactions; Market liberalization processes; Industrial ecology models integrating economic and environmental aspects of the lifecycle of products. - In 2006, the *Energy for Sustainability* initiative was born, gathering around this theme a set of disciplines, Schools, I&D units, professors and investigators; - Over the last years, UC took several steps to potentiate energy reduction and energy efficiency, such as energy audits in several buildings, correction of the power factor or upgrade of lighting systems and electrical systems in general. - In 2007, UC became a partner of the *Green Light* initiative. A project is in course to completely replace incandescent lamps by compact fluorescent lamps. An application presented by UC to replace the common fluorescent lamps of four large buildings by lighting systems with electronic ballasts and high-efficiency lamps was selected by ERSE within the scope of the Energy Efficiency Promotion Plan for Electric Power Consumption; - Students at UC regularly develop activities that are strongly connected to improving energy efficiency at the University campi, within the scope of curricular activities of Graduation or Master's Degree courses, such as projects or dissertations; - Additionally, UC has adapted waste minimization processes for several categories. There is also a responsible hazardous laboratorial waste handling policy. This sustainability promotion strategy also involves an acquisition policy that privileges the environmental component for a growing number of them;

Fig. 2 Curriculum for sustainability initiatives at the University of Coimbra. *Source* GREEN_UC. See more at: http://www.uc.pt/efs/green_uc

several actions jointly with the Community. Among them are the **External Advisement and Standardization Committee** (**CEAA**), consisting of 26 companies and 5 organizations, qualification initiatives, business consultancies, projects with associated companies, in addition to being open to new initiatives and partnerships. The role of Higher Education Institutions as responsibility catalyzers for society, as local communities, companies and societies are beneficiated by the presence of universities, is such that they may intervene in the social environment, promoting sustainable development initiatives.

COMMUNITY
- **External Advisement and Standardization Committee (CEAA)** - it is constituted by investigators and employers outside UC, whose role is to organize the reflection on the strategy of UC for the area of Energy for Sustainability and to evaluate the concretization of the objectives of the EfS initiative and the qualification developed within its scope; - **26 companies and 5 organizations** are currently represented at **CEAA**; **- EfS Initiative Meetings, Students and Companies –** The Energy for Sustainability Initiative at UC promotes an annual meeting between the students from its Master's Degree and Doctorate programs, professors, companies and organizations form its External Advisement and Standardization Committee (CEAA); **- University of Coimbra** (UC) **–** A reference in higher education and investigation in Portugal, whether due to the quality of the courses offered by its eight schools, or due to the advancements obtained in investigations on several scientific domains. The *Energy for Sustainability* – EfS – initiative is one of the manifestations of this policy. This initiative gathers professors from different scientific disciplines, with vast experience in teaching, investigation, transferring technology and **consultancy** in the areas of energy and sustainable development; **- The EfS Initiative -** Objective: to respond to the challenges involved in the conception, operation and regulation of systems that produce, transport or use energy; transfer of knowledge to Society through the interaction with decisions from politicians, managers and technicians that occupy or intend to occupy positions of responsibility in the several activity sectors, involving companies and other organizations identified with their objectives; **- Advanced qualification programs –** They are offered by UC, within the context of the EfS Initiative, for graduates or masters in engineering, architecture, economy and management, as well as for professionals interested on this area, in association with the MIT Portugal Program. **- Cooperation opportunities –** They are offered by the EfS Initiative and are mutually beneficial between UC and companies and other organizations; - **Advanced qualification programs**, namely the Doctorate in Energy for Sustainability or the Master's Degree in Energy for Sustainability. In addition to these program, shorter courses are also offered and it will also be possible to conceive **on demand courses** for a certain organization; - Master's Degree and Doctorate papers within the business context; - Support from the secretariat to **recruit** students that are about to complete their courses and that search for a position that allow them to apply their skills and knowledge acquired throughout the program; - Exploring opportunities to establish **joint projects** for collaboration and I&D, with the possibility of integrating the scientific work of Master's Degree and Doctorate students; - Offering **consultancy** on the themes related to the EfS Initiative, such as analysis of the lifecycle of products, energy efficiency or engineering problems; **- Disclosing** the EfS Initiative on the website; - Promoting and offering **services** through the Innovation and Knowledge Transfer Division of UC, such as the protection of products and processes, support to financing programs, or support to the creation of technology-based companies; **- The Coordination of the** *Energy for Sustainability* **Initiative invites companies and other organizations that could be potentially interested to be part of this initiative.**

Fig. 3 Initiative of the University of Coimbra for the Community. *Source* GREEN_UC. See more at: http://www.uc.pt/efs/green_uc

5 Conclusions

The role of higher education on the discussions on sustainability goes beyond the teaching/learning relationship seen on classrooms. The concept extends toward the involvement in extra-curricular projects with the surrounding community, aiming at effective solutions for the local population. Although it has a fundamental role in the development of a sustainable socioenvironmental awareness, education is not able to implement sustainability without taking concrete measures. It is up to the

Universities to put into practice what they teach, making its own internal management a sustainable management model, also influencing with its results the organizations which their graduates will be a part of.

Within this context, from the observation of the state of the art on universities and sustainability, an attempt was made to understand how a Portuguese university develops the sustainability perspective, by analyzing the sustainability-driven skills. The references used allowed an understanding on how sustainability is applied to the studied subject matter.

The position of the studied University is in agreement with the definition of a sustainable university campus, as suggested by the current literature, which emphasizes energy saving, preservation of resources and waste reduction. Under this perspective, through its environmental management, the university has the possibility to promote equality and social justice and to extrapolate values to the entire national and global community.

The case evidence showed the aspects observed by Wright (2002) as essential aspects on a sustainable university. The sustainable campus operations, sustainable investigation, awareness of the audience, cooperation among institutions and sustainable curriculums are concerns that emerge on the publications on the website of the University.

It may be observed that the institution does not yet publish sustainability reports, with a clear disclosure of the reached goals and with the challenges and non-conforming situations. Elaborating and publishing reports could be a way to make the information more transparent and accessible to all stakeholders.

The study conducted at the Portuguese University allowed to observe complex physical and organizational structures. The issue of sustainability is a permanent challenge to the characteristic immobility of human ancestry and the characteristic scattered attention of multilevel organizations. Since it is not viable to meet all the demands of environmental sustainability nor to count on the speed of the newer institutions, the University tries, however, to take on the opportunities resulting from each threat, managing the resources considering this imperative.

References

Bardin, L. (2011). *Análise de conteúdo*. Lisboa, Portugal: LDA.

Barth, M., et al. (2007). Developing key competencies for sustainable development in higher education. *International Journal of Sustainability in Higher Education, 8*(4), 416–430.

Barth, M., & Rieckmann, M. (2012). Academic staff development as a catalyst for curriculum change towards education for sustainable development: An output Perspective. *Journal of Cleaner Production, n., 26*, 28–36.

Brandão, H.P., & de Guimarães, T. A. (2001, Jan/Mar). Gestão de competências e gestão de desempenho: Tecnologias distintas ou instrumentos de um mesmo construto? RAE—Revista de Administração de Empresas, São Paulo, vol. 41, no. 1, pp. 8–15.

Brundiers, K., Wiek, A., & Redman, C. L. (2010). Real-world learning opportunities in sustainability: from classroom into the real world. *International Journal of Sustainability in Higher Education, 11*(4), 308–324.

Burandt, S., & Barth, M. (2010). Learning settings to face climate change. *Journal of Cleaner Production, 18*, 659–665.
Clark, G. (2007). Evolution of the global sustainable consumption and production policy and the United Nations Environment Programme's (UNEP) supporting activities. *Journal of Cleaner Production, 15*(6), 492–498.
Dobson, A. (2007). Environmental citizenship: Towards sustainable development. *Sustainable Development, 15*, 276–285.
Draganidis, F., & Mentzas, G. (2006). Competency based management: A review of systems and approaches. *Information Management & Computer Security, 14*(1), 51–64.
Drejer, A., & Riis, J. O. (1999). Competence development and technology: How learning and technology can be meaningfully integrated. *Technovation, 19*(10), 631–644.
Du, X., Su, L., & Liu, J. (2013). Developing sustainability curricula using the PBL method in a Chinese context. *Journal of Cleaner Production, 61*, 80–88. doi:10.1016/j.jclepro.2013.01.012.
Dutra, J. S., Hipólito, J. A. M., & Silva, C. M. (2000, Jan/Abr). Gestão de pessoas por competências: o caso de uma empresa do setor de telecomunicações. RAC, *4*(1), 161–176.
Edgar, W. B., & Lockwood, C. A. (2008). Organizational competencies: Clarifying the construct. *Journal of Business Inquiry: Research, Education and Application, 7*(1), 21–32.
Gombert-Courvoisier, S., et al. (2014). Higher education for sustainable consumption: Case report on the Human ecology master' s course (University of Bordeaux, France. *Journal of Cleaner Production, 62*, 82–88. doi:10.1016/j.jclepro.2013.05.032. Last accessed March 22, 2014.
Isambert-Jamati, V. (1997). O apelo à noção de competência na revista L'orientation Scolaire et Profissionelle. In F. Ropé & L. Tanguy (Orgs.), *Saberes e competências: o uso de tais noções na escola e na empresa* (pp. 103–133). Campinas: Papirus.
Müller-Christ, G., et al. (2015). The role of campus, curriculum, and community in higher education for sustainable development—A conference report. *Journal of Cleaner Production*, *62*, 134–137. doi:10.1016/j.jclepro.2013.02.029. Accessed March 17, 2014.
Prahalad, C. K., & Hamel, G. (1990, May/June). The core competence of the corporation. *Harvard Business Review*, *68*(3), 79–91.
Rychen, D. (2003). Key competencies: Meeting important challenges in life. In D. Rychen & L. Salganik (Eds.), *Key competencies for a successful life and wellfunctioning society* (pp. 63–107). Cambridge: Hogrefe & Huber.
Thomashow, M. (2014). *The nine elements of sustainable campus* (p. 2014). USA: Massachusetts Institute of Technology.
UNESCO. (2014). United Nations Educational, Scientific and Cultural Organization. Shaping the future we want: With the support of UN Decade of Education for Sustainable Development (2005–2014); final report. Paris, France.
Vilches, A., et al. (2012). The need for contributions to the decade of educate for a sustainable future: An ethical commitment. In W. Leal Filho (Ed.), *Environmental education, communication and sustainability*. Frankfurt: Peter Lang.
Wals, A. E. J. (2014). Sustainability in higher education in the context of the UM DESD: A review of learning and institutionalization processes. *Journal of Cleaner Production*, *62*, 8–15. doi:10.1016/j.jclepro.2013.06.007. Last accessed March 22, 2014.
Wright, T. (2002). Definitions and frameworks for environmental sustainability in higher education. *International Journal of Sustainability in Higher Education, 3*(3), 203–220.
Yasin, R. M., & Rahman, S. (2011). Problem oriented project based learning (POPBL) in promoting education for sustainable development. *Procedia Social and Behavioral Sciences, 15*, 289–293.
Yin, R. K. (2015). *Estudo de caso: planejamento e métodos* (5th ed.). Porto Alegre: Bookman.
Zarifian, P. (2001). *Objetivo competência: Por uma nova lógica*. São Paulo: Atlas.

Authors Biography

Thiago Antonio is Beuron Administration Professor at the Federal University of Pampa—UNIPAMPA—RS. Doctor in Business Administration from the Post-Graduate in Business Administration from the Federal University of Santa Maria—PPGA—UFSM, participated in the Scholarship Program Institutional Doctoral Sandwich abroad—PSDE at the Faculty of Economics, University of Coimbra—FEUC, Portugal. Master in Business Administration from PPGA—UFSM (2012). Bachelor in Business Administration from the State University of the Midwest—UNICENTRO—PR (2009). He has experience in the area of Administration, emphasis in Strategy and Organizational Behavior. A member of the research groups: Research Group Management and Organizations Collective—UFSM; Studies and Research in Strategy, Innovation and Sustainability—UFSM.

Lucas Veiga Ávila is Professor of the State University of Rio Grande do Sul Assistant—UERGS; Postgraduate Course Coordinator—Specialization in Leadership and Sustainability, Group Leader of the Research: Management and Organizational Development at the University Unit UERGS; PhD in Administration at UFSM. Magazine Executive Director of Management and Organizations Cooperatives—RGC. A Masters in Business Administration from Universidade Federal de Santa Maria—UFSM. Specialist in Strategic Business Management for Integrated Regional University—URI. Degree in Business Administration from Universidade Regional Integrada—URI. Research on issues involving: environmental management; sustainability; Quality Management and Environmental production; public administration; Public planning; planning and Universities.

Luciana Londero Brandli is graduated in Civil Engineering (1995), master's degree in Civil Engineering (1998) and Ph.D. in Production Engineering (2004). Pos Doctorial Research at Hamburg University of Applied Sciences (2014). She is currently Associate Professor in the University of Passo Fundo, south of Brazil, working in the Master Program in Engineering, Infrastructure and Environment. Her current research interests include sustainability in high education and green campus, environment management, management of urban infrastructure, sustainable cities and green buildings.

Filipe Jorge Ribeiro Almeida graduated in 1997 in Organization and Management from the Faculty of Economics, University of Coimbra (FEUC). In 2001 he held the Master in Business Administration with specialization in Business Strategy, by FEUC. In 2008 he obtained equivalence to Doctor Degree in Business Administration, with specialization in strategy, the FEUC. It is a teacher of the Faculty of Economics, University of Coimbra since 1997 in undergraduate programs, masters, MBA and PhD. Disciplines taught: Ethics and Corporate Social Responsibility (regency), Business Ethics (regency), Organizational Behavior (regency), Human Resource Management, Financial Accounting, Marketing and Introduction to Management.

Lúcia Rejane da Rosa Gama Madruga graduated in Business Administration from Universidade Federal de Santa Maria (1988), Full Degree in Mathematics—Franciscan University (1984), master's degree in Production Engineering from the Federal University of Santa Maria (1994) and doctorate degree in Agribusiness from the Federal University of Rio Grande South (2009). He is currently an adjunct professor at the Federal University of Santa Maria. It has experience in university governance and works in administration, with an emphasis on people management, public management, agribusiness, sustainability, environmental responsibility and social learning.

Eduardo Jorge Gonçalves Barata Is Assistant Professor of the Faculty of Economics, University of Coimbra. MSc in Financial Economics University of Coimbra, Portugal. Degree in Economics, University of Coimbra, Portugal.

Sustainable Campus in a Historical Town: The "Ca' Foscari University of Venice" Case Study

Fabio Pranovi

Abstract

Venice is a place of strong contrasts and contradictions. Depending on the point of view, Venice can be described as an example of sustainability, in terms of the presence of an urban tissue *co-evolved* with surrounding lagoon, or of unsustainable exploitation, e.g. hosting millions of tourists per year in spite of an extremely fragile tissue. Within this context, what is the University role, if any, and what does it mean sustainable Campus? Being located in a very ancient town, the Campus is necessarily spread across the town, with almost 30 venues, often hosted in historical buildings, some old of centuries. Since 2010, Ca' Foscari assumed Sustainability as one of the pillar of its developing strategy for the future, directly assuming it in the Statute. In that year, indeed, the Sustainable Ca' Foscari project was inaugurated, aiming to include sustainability as a guiding principle for all University activities. The sustainability program is based on two different mainstreams, considering both the top-down and the bottom-up approaches. On one side, the work on structures and infrastructures, on the other, the involvement of both people living the Campus and constituting the University community, and those living outside it, that is Venetian society. In this paper, a description of the main activities and their possible effects on the city is reported.

Keywords

Higher education · Integrated sustainability · Urban university · Sustainable campus · Ca' Foscari University · Venice

F. Pranovi (✉)
Rector Delegate for Sustainability, Ca' Foscari University of Venice, Campus Scientifico, via Torino 155, 30170 Venice, Italy
e-mail: fpranovi@unive.it

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_9

1 Introduction

Sustainability represents one of the main challenge for our society. As stated by Irina Bokova (General Director of UNESCO) it mandatory "learning to develop sustainably in an age of limits". The urgency of the present situation is well represented by the Agenda for Sustainable Development launched by the United Nations for 2030 (Transforming our world: the 2030 Agenda for Sustainable Development, September 2015). The agenda identifies four major areas of interest: People, Planet, Prosperity, Peace. The action is declined according to 17 Sustainable Development Goals (SDG) and 169 targets. "They seek to realize the human rights of all and to achieve gender equality and the empowerment of all women and girls. They are integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental". All this calls for the implementation of the concept of integrated sustainability, which is the need to overload the three spheres paradigm towards a real integration of the environmental, social and economic issues, by adopting a holistic approach. In order to achieve environmental objectives, indeed, it is necessary to directly involve stakeholders, also taking into the account the economic issues; on the other side, in order to gain aims as equality, stopping hunger and poverty, it is necessary to solve the critical environmental issues threatening the Planet.

Within this context what is the role of the Higher Education? An answer to this question could be find in the premise to the Incheon Declaration by the UNESCO:

"Our vision is to transform lives through education, recognizing the important role of education as a main driver of development and in achieving the other proposed SDGs. We commit with a sense of urgency to a single, renewed education agenda that is holistic, ambitious and aspirational, leaving no one behind. This new vision is fully captured by the proposed SDG 4 "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" and its corresponding targets. It is transformative and universal, attends to the 'unfinished business' of the Education for All (EFA) agenda and the education-related Millennium Development Goals (MDGs), and addresses global and national education challenges. It is inspired by a humanistic vision of education and development based on human rights and dignity; social justice; inclusion; protection; cultural, linguistic and ethnic diversity; and shared responsibility and accountability. We reaffirm that education is a public good, a fundamental human right and a basis for guaranteeing the realization of other rights. It is essential for peace, tolerance, human fulfilment and sustainable development. We recognize education as key to achieving full employment and poverty eradication. We will focus our efforts on access, equity and inclusion, quality and learning outcomes, within a lifelong learning approach" (UNESCO 2015, p. iii).

Given the central role of education, Universities, which have historically played a role in transforming societies and in serving the greater public good, being recognized as the place of custodians of wisdom, continuity of knowledge and professional skills for employment, are requested to deeply modify themselves

becoming holistic, transformative and envisioning for the change (Waghid 2008; Waas et al. 2010). Moreover, for coping with complex systems, a strong inclination towards the interdisciplinarity and also multidisciplinarity is required (Stephens and Graham 2010). For some instances, Universities are required to be incubators of change. The Sustainable Development should be a core issue that universities are expected to address by fostering research, spreading knowledge, and promoting new competencies and behavioral models in order to encourage more globally responsible actions by stakeholders and citizens (Stephens et al. 2008). Such a mission should first involve their primary institutional functions: teaching (at various levels) and research viewed in a synergetic relationship. But it should also require the engagement of all relevant stakeholders—professors, students, researchers, suppliers, manager and surrounding community—in the implementation of actions aiming in putting sustainable development into practice, within the Universities themselves as well as the communities and territories hosting them.

At present, Universities are hardly working about these issues, mainly concentrating on assuming commitments and goals on campus sustainability and the integration of research, teaching, outreach and facilities for sustainability, often increasing the networking activities.

This paper aims to describe the experience of the Ca' Foscari University of Venice in implementing the sustainability issues within the context of a heritage city, also investigating the possible role as urban university, that means how to accelerate the pace of working to help to make the transition to a truly sustainable society.

2 Ca' Foscari University as Showcase

The town of Venice represents an optimal case study within the Sustainability implementation context, being a place of strong contrasts and contradictions. Depending on the point of view, Venice can be described as an example of sustainability, in terms of the presence of an urban tissue *co-evolved* with surrounding lagoon (Solidoro et al. 2010), or unsustainable exploitation, hosting millions of tourists per year within an extremely fragile context (Russo 2002).

About the last issue, just few examples among the others. Venice is threatened by the flooding risk, linked to the high tide (due to combined effects of the sea-level rise and subsidence) and till now a lot of efforts (also in monetary terms) have been devoted to solve this problem (see for instance https://www.mosevenezia.eu/). But this is expected to produce a disconnection, at least partial, between the lagoon and the coastal environment, with poorly known effects on the entire ecosystem functioning.

Another criticism, probably more dangerous than the previous one, which received, paradoxically, quite less attention, is related to the mass tourism. Every year, approximately 22 million tourists visit Venice, of whom just four million stay in Venice overnight, and only two million visit one or more cultural attractions,

such as museums or art exhibitions. It was thus pointed out that tourism in Venice is not to be considered as 'cultural' at all; in fact, tourism in Venice could be better described as "free-riding on the city's cultural beauty". Modeling analysis estimated that the total carrying capacity of the city is slightly less than 11 million visitors, instead of the double number of presences. All this clearly indicates an emergency in terms of sustainability and claims for the development of effective planning and administrative instruments, as well as of suitable governance mechanisms and strategic policies for managing tourism that should thus be considered as top priority for the future of Venice. At present, the debate about this issue is still open and often harsh, but the question of the overall sustainability of the town is simply do not taken into consideration.

Having all this in mind, some questions rise. What is the role, if any, of the University? Which are the actions to improve the awareness on sustainability issues? What could it mean to create a sustainable campus?

Within this context, it could be challenging to talk about sustainability and to find ways and ideas to implement it.

2.1 The Sustainability at Ca' Foscari University

Ca' Foscari is a medium-size University, enrolling about 21000 students (many of them living in the town), offering 16 Bachelor's degrees, 30 Master's degrees and 34 Professional Masters Programme, in addition to 14 Doctorate courses. It is deeply rooted in the urban tissue, being founded in 1868 as Royal Business College (the first educational institution in Italy to offer higher education in Business and Economics).

Being located in a heritage city, the Campus is necessarily spread across the town, with almost 30 venues, often hosted in historical buildings, some old of centuries. All this, however, required a re-adaptation of these structures to new uses (e.g. classes and meeting halls), with many criticisms and limits—architectonic, historical and of safety—posed by the structures themselves and by local authorities. This high vulnerability and fragility claims for a great 'caution in handling'.

Since 2010, Ca' Foscari assumed Sustainability as one of the pillar of its developing strategy for the future, directly assuming it in the Statute. In that year, indeed, the Sustainable Ca' Foscari project was inaugurated, aiming to include sustainability as a guiding principle for all University activities. All this imposed a rethinking of all the structures and processes. The main idea was to work towards greater sustainability via activities and projects aimed at reducing the Institution's impact on the environment and on natural resources, as well as bettering students, faculty and staff wellbeing.

The Ca' Foscari Sustainability program can be summarized in two different mainstreams. On one side, the work on structures and infrastructures (e.g. buildings and administration), on the other, the involvement of both people living the Campus and constituting the University community, and those living outside it, that is the

Venetian citizens. The working idea is to implement an integrated sustainability, defining clear objectives in order to better plan the management strategies.

In terms of the buildings management, the strategy is a sort of 'improving maintenance', with small scale interventions finalized towards objectives, like the reduction of energy consumes, working on the power supply, but also on architectonic solutions to increase thermal isolation (Table 1).

Within this context, a good example is represented by application for the LEED certification to the Ca' Foscari main building. In September 2013, indeed, the Ca' Foscari headquarter, a 560 years old gothic palace on Canal Grande, was rewarded with the LEED EB: O&M (Leadership in Energy and Environmental Design Existing Building: Operation & Management) Certificate, becoming the oldest "green" building in the world. This represented a double challenge: firstly to obtain the certification (e.g. adapting the LEED standard to a historical building) and then to adopt maintenance protocols able to improve the general state, allowing maintaining the certification through the time (Table 1).

The LEED Certification, promoted by the US Green Building Council is a rating system, which evaluates the degree of buildings' resource management, maintenance and efficiency. The idea is radically transforming the way we think about how buildings and communities are designed, constructed, maintained and operated. To receive LEED certification, building projects have to satisfy prerequisites and earn points to achieve different levels of certification. Prerequisites and credits differ for each rating system, and teams choose the best fit for their project. It also represents a useful guide on how to cut management and maintenance costs and how to implement eco-friendly actions of immediate application. The fields of intervention to obtain the certification were water consume efficiency, energy consume and green energy supply, wastes management, green public procurement and sustainable mobility.

Table 1 The principal measures/projects adopted within the context of the Sustainable Ca' Foscari project

Context	Measure/project	Expected output
Structure/infrastructures	Improving maintenance	The general efficiency improvement, with small-scale interventions
	LEED certification	The operational guidelines production to be used in different buildings
	Carbon emission certification	See the previous
Stakeholders engagement	Art projects	The students awareness increase, by involving them in emotional communication projects
	Carbon footprint calculator	The availability of a simple tool to orienteer the personal life style
	Consumes engagement	The reduction of the energy and heating consumes by modifying individual behaviors and also act on the personal life style

For Ca' Foscari, this was only the first step; the certification objectives represent now the guidelines on which operate in order to improve the performance and maintain the standards for the certification renewal.

In general, the carbon emission certification is another important challenge, adopted by Ca' Foscari to help in the objectives definition and putting in place the right management strategies (Table 1). In the same context, the decision to become part of international rankings and networks (as UI Green Metric World University Ranking, and International Sustainable Campus Network) can be viewed as useful to define objectives and to fix thresholds and reference points.

All these measures represent 'top down' interventions; the University governance decided to have the Sustainability as key part of the strategic planning, and adopted necessary commitments to modify structures and infrastructures. It is, however, well-known that the success of management policies is related to the stakeholders' involvement (Freeman 2010). Within this context, a 'bottom up' approach has been contextually implemented, directly involving people living the University, both personnel and students. The main idea behind this, is that the University is primarily done by the human capital (individuals, their ideas and behaviors) and only secondarily by the structures and infrastructures.

Two ways has been adopted for increasing the awareness:

- involving people in events and projects about sustainability issues;
- engaging people to verify how their life style affects the Campus sustainability and how little changes in it can produce positive impacts.

Particular attention has been devoted to the use of 'alternative' communication channels, in order to vehiculate messages and stimulate emotions (Table 1). Within this context, one of the most successful experience realized by Ca' Foscari, in terms of students' and community involvement in the sustainability matters, is the connection between Sustainable Ca' Foscari and the Art world. So far, Sustainable Ca' Foscari has hosted two art projects (the "Garbage Patch State" by Maria Cristina Finucci and the "Dancing Solar Flowers" by Alexandre Dang), both with a wide participation of students from different disciplines. By taking part in these projects, students were given the opportunity not only to get to know international artists firsthand, but also to put in practice their own cross competencies and to give free reign to their own creativity, by actively working on the project.

On the other side, it has just been released the new version of the Ca' Foscari Carbon Footprint Calculator (http://virgo.unive.it/footprint/cfp/) (Table 1). It represents an output of a project funded by the Italian Ministry of the Environment and Protection of Land and Sea, which allows modeling the CO_2 emission related to different life styles. The idea is to spur students, staff and faculty to check and reduce their own carbon emissions, helping them to adopt strategies and corrective actions. The present version is based on the gaming approach, trying to stimulate the competition among students and personnel belonging to different Departments.

Finally, it has just launched a very new project aiming to directly involve Ca' Foscari personnel in their energy consumes. The idea is to realize an interface

to make available in real time the consuming data for small portion of Campus buildings to the people using that area. In this way, they become responsible of their own consumes and can try to reduce them changing, if possible, their life style. We are now testing this in a pilot case study, the Scientific Campus, but the idea is to extend it to the different University buildings (Table 1).

3 Discussion

"Universities have a critical role to play in educating future generations, disseminating information about sustainability, and particularly by training leaders with the skills to solve regional and local problems from a global and interdisciplinary perspective. Especially crucial is the fostering of human resources to work toward sustainability in the developing nations that bear the brunt of global environmental problems. A network of networks can also provide opportunities for collaborating universities to develop and improve higher education capacity in their respective nations and regions" (Sapporo Sustainability Declaration, G8 University Summit, Japan, 2010, p. 3).

The recognition of the crucial role played by Higher Education for the Sustainable Development of our society, in some ways, allow us to overcome the debate about the University and its possible crisis, developed within the context of social sciences in the last decades (for a synthesis see Delanty 2001).

All this, however, claims for a deep change of the University, in terms of structures, research and teaching. As pointed out also by the modernisation agenda of European higher education (Commission of the European Communities 2006), Universities have to modify their public role, creating opportunities where things can be made public and can become a matter of public concern, and where publics can constitute themselves around such issues (Biesta et al. 2009).

Since the Rio Declaration (1992), in relation to the sustainability issues, a crucial role has been recognized to the local scale and the cities in particular. They represent, indeed, places in which the energy consume, waste production and emission concentrate, due to the high concentration of economic activities; they represent the right scale at which the environmental problems can be faced; moreover, they host the decisional power, main economic resources and finally also centers of excellence for education and research.

All this directly recall the metropolitan university concept (Mulhollan 1995), according to which "urban university manifests a deep sense of responsibility to its urban constituencies and attempts to assist them in coping with their problems" (Martinez-Brawley 2003).

In relation to this, some questions rise. How the Ca' Foscari University can contribute to the implementation of Sustainability in a heritage city as Venice? How are we going to produce meaning and encourage positive action in a knowledge system shattered by postmodernity, the proliferation of interests, and often conflicts or tensions between different alternatives?

One possible suggestion comes from the Sapporo Sustainability Declaration, art. 8. “Another potential role for universities in the effort to attain sustainability is the use of their campuses as models for a sustainable society, based on interactions with various stakeholders in society through the academic research and education processes. Universities can provide venues in which to test new sustainability-relevant knowledge in a social context. Activities already being undertaken by participating universities, such as the development of “sustainable” or “green” campuses, and the issuing of action statements in response to climate change, are examples of how to showcase a sustainable society. By serving as test models for society at large, universities help foster in their students the attitudes and skills necessary to achieve a sustainable society in the future. Thus the sustainable campus can serve as both an experiment in progress and an ideal tool for educating future generations” (Sapporo Sustainability Declaration, G8 University Summit, Japan, 2010, p. 3).

All the measures/projects above described (Table 1) are primarily reversed inside the University, in order to implement commitments towards a more sustainable Campus, but the can also become a reference for the surrounding city. For instance, Ca’ Foscari University, by its own specific research skills, can drive the conservation process of historical buildings, suggesting the best ways to treat stones and other concretes, to preserve paintings and to recover them after time damages. Nevertheless, it can also contribute in enlarging the view, moving from specific issues to a general view. It can contribute in deciding what we want to preserve in Venice (and its surrounding lagoon environment). The challenge is to preserve a dynamic system, changing through the time, and for which it is quite impossible to fix (and maintain) a single snapshot. Ca’ Foscari has to give its contribute to realize that it is simply impossible to preserve everything, ‘as it was and where it was’; that is needed to preserve the resilience of the system, the capability to cope with the external perturbations without changes the critical internal processes. Moreover, recognizing the crucial role of citizen, in terms of social tissue, for the maintenance the town (and its lagoon still alive).

Being innovative, creative, experimenting, indicating new ways, suggesting new strategies, being sentinel for changes, Ca’ Foscari could affect the local and regional policies. Within this context, the LEED certification can be considered a clear signal to the town and policy makers. Indeed, an important question in Venice is how to conjugate heritage and the eco-efficiency and eco-innovations. Ca’ Foscari demonstrated that it is possible to move towards sustainability, also considering historical buildings.

4 Conclusions

All this represents a challenge for the Ca’ Foscari University: to be able to implement an integrated Sustainability approach, acting inside, modifying both infrastructures and behaviors, but also taking upon itself the additional

responsibility of providing leadership to its metropolitan region by using its human and financial resources to improve the region's quality of life.

Within this process, some possible limitations can be identified.

First, the implementation of the integrated sustainability concept, claiming for interdisciplinarity and multidisciplinarity, is often frustrated by the presence, inside the University, of strong and historically well-defined boundaries among the different disciplines.

On the other side, Universities are suffering for a strong resources reduction, limiting their choosing capability and in some cases the opportunity for long term programs and strategies, as typically those required for the sustainability issues.

Finally temporal and spatial ties. The reconstruction of the Venetian urban and social tissue will require a long time and the adoption of new more adequate policies by local authorities, and so the real opportunities of the Ca' Foscari University to affect the processes will be a sort of long term experiment with scarce possibilities to act with the try and error method. Moreover, it will require to work on the local scale, but in the context of the global perspective.

Future perspectives. As highlighted also by the Sapporo Sustainability Declaration, the creation of network and network of networks represents a crucial issue, on one side allowing to share experiences and best practices, on the other enlarging the action radius both in spatial and temporal terms. For this reason, Ca' Foscari is coordinating, with other Italian Universities, the creation of an Italian network of Universities for the Sustainability.

References

Biesta, G., Kwiek, M., Lock, G., Martins, H., Masschelein, J., Papatsiba, V., et al. (2009). What is the public role of the University? A proposal for a public research Agenda. *European Educational Research Journal, 8*, 249–254.

Delanty, G. (2001). The university in the knowledge society. *Organization, 8*, 149–153.

Freeman, R. E. (2010). *Strategic management. A stakeholder approach* (p. 266). New York: Cambridge University Press.

Martinez-Brawley E. (2003). The metropolitan mission of a research university: a study of the context and opportunities for faculty. College of Extended Education Arizona State University.

Mulhollan, P. E. (1995). Aligning missions with public expectations: The case of the metropolitan universities. In D. M. Johnson & D. A. Bell (Eds.), *Metropolitan universities: an emerging model in American higher education*. Denton, TX: University of North Texas Press.

Russo, A. P. (2002). The "vicious circle" of tourism development in heritage cities. *Annals of Tourism Research, 29*, 165–182.

Solidoro, C., Bandeli, V., Aubry Bernardi, F., Camatti, E., Ciavatta, S., Cossarini, G., et al.. (2010). Response of Venice Lagoon Ecosystem to natural and anthropogenic pressures over the Last 50 Years. In H. Paerl & M. Kennish (Eds.), *Coastal Lagoons: Systems of natural and anthropogenic change* (pp. 483–511). Marine Science Book Series. New York: CRC Press, Taylor and Francis.

Stephens, J. C., & Graham, A. C. (2010). Toward an empirical research agenda for sustainability in higher education: Exploring the transition management framework. *Journal of Cleaner Production, 18*, 611–618.

Stephens, J. C., Hernandez, M. E., Roman, M., Graham, A. C., & Scholz, R. W. (2008). Higher education as a change agent for sustainability in different cultures and contexts. *International Journal of Sustainability in Higher Education, 9*, 317–338.

UNESCO. (2015). Education 2030. Incheon Declaration. Towards inclusive and equitable quality education and lifelong learning for all. World Education Forum 2015 in Incheon, Republic of Korea.

Waghid, Y. (2008). The public role of the university reconsidered. *Perspectives in Education, 26*, 19–24.

Waas, T., Verbruggen, A., & Wright, T. (2010). University research for sustainable development: Definition and characteristics explored. *Journal of Cleaner Production, 18*, 629–636.

Author Biography

Fabio Pranovi is Assistant Professor in Ecology at the Department of Environmental Sciences, Informatics and Statistics, Ca' Foscari University, Venice. He dedicated his career in researching and teaching about Sustainability issues, with a particular emphasis to the exploitation of natural resources. The main research interests are in the fields of: Renewable resources exploitation in marine environment; Implementation of ecosystem indicators to assess the ecological status, in relation to different drivers and pressures; and Ecological effects of climate changes on the ecological processes.

Since 2015 he is Rector delegate for Sustainability at the Ca' Foscari University of Venice. He dedicated his activity in the implementation of the integrated sustainability concept, both inside and outside the Campus, with particular focus on the interactions with the heritage city.

The Role of University Centers in Environmental and Sustainability Education in Envisioning Futures

Peter Blaze Corcoran, Joseph P. Weakland and Brandon P. Hollingshead

Abstract

This paper considers the role that university centers in environmental and sustainability education might play in envisioning futures for the field—as well as for tomorrow's campus. The paper attempts to move the conversation of "the future" beyond a general or rhetorical sense and instead toward how university centers might participate in the collective, institutional, intergenerational, and social processes necessary to imagine, design, and actualize alternative, sustainable futures. This working understanding of "the future" comes from within traditional sustainability discourse on "present and future generations," such as intergenerational education and intergenerational justice—as well as discourse further afield, such as speculative movements within the fields of design and architecture. University research centers in environmental and sustainability education are particularly suited to the task of envisioning socio-ecological futures, as they have been successful in promoting the mainstreaming of sustainability in home institutions, in academe, and in the larger culture and society. Centers are able to develop programs for and with students, connect the university to other communities, work with government,

P.B. Corcoran (✉)
Department of Marine and Ecological Sciences, Florida Gulf Coast University, 10501 FGCU Boulevard South, Fort Myers, FL 33965, USA
e-mail: pcorcora@fgcu.edu

J.P. Weakland
Department of Literature, Media, and Communication, Georgia Institute of Technology, 121 Stephen C. Hall Building, 215 Bobby Dodd Way, Atlanta, GA 30332, USA
e-mail: jweakland3@gatech.edu

B.P. Hollingshead
Department of Communication and Philosophy, Florida Gulf Coast University, 10501 FGCU Boulevard South, Fort Myers, FL 33965, USA
e-mail: bhollingshead@fgcu.edu

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_10

involve industry, and encourage scholars to explore intergenerational learning and transformative leadership for sustainability. Centers are a platform for interdisciplinary knowledge creation and feed sustainability ideas into universities and other societal institutions that they are not able to produce on their own. Centers, then, can be a place to envision futures for environmental and sustainability education, for tomorrow's campus, and for Earth.

Keywords
Envisioning futures · University centers · Environmental and sustainability education · Intergenerational ethics · Higher education

1 Introduction

Environmental education is at a critical moment. The field marks 40 years since its official launch at Tbilisi, Georgia, in 1977. The United Nations Decade of Education for Sustainable Development (UNDESD) has ended in 2015, as did the United Nations Millennium Development Goals. The United Nations (UN) has launched the Sustainable Development Goals (SDGs) with extraordinary international agreement on the need to create a just, peaceful, and sustainable future. In late September 2015, the UN adopted 17 SDGs intended to "end poverty, protect the planet, and ensure prosperity for all," with specific benchmarks to be achieved over the next 15 years (UN 2015). Further, the United Nation's Global Action Programme on Education for Sustainable Development "seeks to generate and scale-up concrete actions in ESD" and contributes to the post-2015 agenda (UNESCO 2014b). An understanding of "strong sustainability" and education for sustainable development emerges from declarations and initiatives of the United Nations, such as the UNDESD and Agenda 21; civil society initiatives such as the Earth Charter; and the particular cultural, environmental, philosophical, and historical conditions of our nations, our communities, and our universities. Embedded within this concept of strong sustainability is an intergenerational ethic expressed in care for the long term flourishing of Earth's human and ecological communities (Earth Charter International 2000).

The work of creating the future is being done now—and much of it is unsustainable in terms of natural and cultural resources. The future of environmental education is an urgent question in the larger context of the Anthropocene, the geological epoch in which human activities have become the dominant driver in the ongoing evolution of Earth's biosphere. The contemporary ecological moment is characterized by complexity, uncertainty, and "accelerating change" (Wals and Corcoran 2012). While the global impact of anthropogenic climate change is undeniable, the pace of temperature and sea-level rise depends on ecological feedback loops that are not fully understood—and which may be increasing the rate

of biosphere destabilization (Hansen et al. 2015). From a social perspective, the Anthropocene is an age of what humanities scholar Rob Nixon (2011) terms "slow violence," or ecological violence and environmental injustice that occurs on spatial and temporal scales that are hard to understand or represent, most often against the world's poorest peoples.

In light of such developments, educators need strategies for anticipatory engagement with changing socio-ecological realities—both in the present and future—in order to be effective within their various embodied contexts. Environmental educators must engage in imaginative mapping concerning large scale, global processes, as well as create useful, situated knowledge for dissemination within their respective socio-ecological contexts. This chapter explores intergenerationality as a specific example of futures thinking within environmental and sustainability education, examining the ethical nature of relationships between youth, elders, and even future generations. It also considers the role of university research centers in environmental and sustainability education; these centers can bring together students, young faculty, university staff, and established scholars, providing the interdisciplinary space necessary to generate the campus(es) of tomorrow. The chapter concludes by considering a specific project undertaken by the Center for Environmental and Sustainability Education geared toward speculating on futures for the field—particularly in light of the emergent United Nations Sustainable Development Goals.

2 Present and Future Generations in Sustainable Development Discourse

Intergenerational ethics provides a compelling perspective for educational practitioners and theorists to envision sustainable futures. Intergenerational learning bridges divides by bringing together different generations to learn together about each other, including experiences, values, and aspirations for sustainable futures; to learn together about ecological, social, cultural, and economic events relevant to them; and to learn together through shared experiences and training activities designed to develop knowledge and skills for addressing the challenges of sustainability (Hollingshead et al. 2014).

Work in environmental education and education for sustainable development, at an international scale, has largely been driven by organizations and institutions affiliated with the United Nations Environment Programme, UNESCO, the United Nations Decade of Education for Sustainable Development, and other similar efforts. As the field transitions from the "post-Decade" DESD efforts into the new Sustainable Development Goals, it is worthwhile to briefly review how the major declarations, proclamations, and policy initiatives from the United Nations system have considered intergenerationality in general—and intergenerational learning in particular. While the notion of "present and future generations" is widespread in sustainable development discourse, there is little precise language on the meaning,

methods, and goals of such intergenerational work. Often these declarations are asymmetric in their consideration, treatment, and prioritization of generations by privileging the contributions (and potential contributions) of future generations, whilst ignoring the wisdom of elders and (culpability of) past generations.

Attention to "present and future generations" is a common rhetorical device in most major international sustainable development declarations and has shaped the sustainable development discourse for decades. For example, the Declaration of the United Nations Conference on the Human Environment was an early call to "defend and improve the human environment for present and future generations" (1972). The Brundtland Commission famously defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987). Proclamations like the Rio Declaration on Environment and Development (1992), Agenda 21 (1992), Johannesburg Declaration (2002), Rio +20 United Nations Conference on Sustainable Development statement on "The Future We Want" (2012), and, most recently, the resolution adopting the Sustainable Development Goals (2015) all declare ethical imperatives to consider present and future generations.

The outcome document of Rio+20 provides a concise example of the ways in which intergenerational thinking manifests itself within sustainable development policy and discourse:

> We stress the importance of the active participation of young people in decision-making processes, as the issues we are addressing have a deep impact on present and future generations and as the contribution of children and youth is vital to the achievement of sustainable development. We also recognize the need to promote intergenerational dialogue and solidarity by recognizing their views. ("The Future We Want" 2012 Article 50)

Similarly, the United Nations resolution adopting the Sustainable Development Goals states, "The future of humanity and of our planet lies in our hands. It lies also in the hands of today's younger generation who will pass the torch to future generations" (United Nations General Assembly 2015, paragraph 50).

Analysis of these kinds of declarations reveals common features of intergenerationality, including (1) consideration of present and future generations (2) honoring the participation and contributions of children and youth, and (3) intergenerational dialogue and solidarity. In this way, the term "intergenerational" is often used to support the inclusion of children and youth in sustainable development initiatives. Such interpretations of intergenerationality disproportionally focus on children and youth as a protected class and often ignore or marginalize elders. For example, the only reference to older generations in the Sustainable Development Goals is to "address the nutritional needs of adolescent girls, pregnant and lactating women and older persons" (2015 Goal 2.2). The Rio+20 outcome document only mentions elders in two instances, in relation to the elderly as a vulnerable population and in light of disability.[1] Agenda 21 describes the role of the

[1]See Articles 43 and 135.

elderly in sustainable development through language on resource demands and dependency burdens,[2] health needs,[3] and disability.[4] In only a single instance does Agenda 21 promote intergenerational dialogue with older generations,[5] as compared to numerous exhortations on the importance and role of youth (UNCED 1992, 1993). Older generations, elders, and traditional knowledge are missing from the Sustainable Development Goals except for one reference to traditional knowledge in agriculture and animal husbandry (SDGs 2015 Goal 2.5).

3 Envisioning Intergenerational Ethics for Education

The sustainable development movement is invested in meeting the needs of present and future generations and has set several policy measures and made many declarations to take up the project of intergenerational dialogue and collaboration. Such discourse asymmetrically privileges the contributions of rising generations over the "burdens" of aging generations. By envisioning sustainable futures with intergenerationality in mind, however, environmental education theorists and scholars might consider an alternative to "present and future generations," an alternative that goes beyond the categorization of living but temporally distant younger and older generations.

The fields of intergenerational ethics and intergenerational justice provide guidance for considering the asymmetry between the choices made by present generations and the effects felt by future generations: "Our notions of justice have been finely honed around the concept of individual rights as these can be defended against the interests of others," writes Rawls (2001), but "when we move beyond our grandchildren, we falter; for future persons are indeterminate and remote, and one wonders how present persons have duties to such faceless nonentities" (ibid p 62). How are we to act when the environmental and social impact of present choices may not immediately be felt, such as in the case of climate change and economic destabilization? Such is the conundrum of the "pure intergenerational problem" (Gardiner 2003) in which earlier generations impose high uncompensated costs, with compounded burdens, on subsequent generations.

In a groundbreaking report (2012) on "Intergenerational solidarity and the needs of future," (United Nations General Assembly 2013) and in response to input given by several nations and stakeholders to the Preparatory Committee for the United Nations Conference on Sustainable Development, UN Secretary General Ban Ki-moon proposed the establishment of a high commissioner for future generations. Such a commissioner would be an advocate for intergenerational solidarity, undertake research and policy development to enhance intergenerational solidarity,

[2]See section 5.22.

[3]See Agenda 21 section 6.18.

[4]See Agenda 21 section 6.34.

[5]See Agenda 21 section 7.4.

and advise United Nations Member States and affiliated UN entities on matters of intergenerational concern. Primary to this undertaking is recognition of the key role of education for sustainable development. The report states:

> Education is itself critical to intergenerational solidarity, as the means of transmitting accumulated or at least latest scientific and other knowledge to future generations. Concern for future generations rests on an open and critical engagement with moral and ethical choices, carried out by informed stakeholders, at all levels. Possible actions would involve strengthening civic education, education for sustainable development and leadership training to foster attitude changes advancing intergenerational solidarity and justice. In this context, the importance comes to the fore of promoting education for sustainable development…. (UN 2012 Article 27)

If environmental education and education for sustainable development are primary in advancing intergenerational solidarity, how might scholars and educators practice and/or employ intergenerational learning in environmental education and in the project of envisioning futures?

4 Discussion: Centers in Environmental and Sustainability Education

As these issues of intergenerational ethics, climate justice, and "deep" sustainability become more important in higher education, there is a critical need to find a place for them on our campuses—and in the larger international university networks of collaboration.

University research centers in environmental and sustainability education are particularly suited to task of envisioning socio-ecological futures, as they have been successful in promoting the mainstreaming of sustainability in home institutions, in academe, and in the larger culture and society. Centers are able to develop programs for and with students, connect the university to other communities, work with government, involve industry, and encourage scholars to explore intergenerational learning and transformative leadership for sustainability. Centers are a platform for interdisciplinary knowledge creation and feed sustainability ideas into universities and other societal institutions that they are not able to produce them on their own. University centers are also powerful spaces for intergenerational collaboration. For example, the authors' own Center for Environmental and Sustainability Education provides pre-professional development opportunities for young people, and puts young scholars into contact with leading thinkers and practitioners within the field both locally and globally. Centers, then, can be a place to envision futures for environmental and sustainability education, for tomorrow's campus, and for Earth.

4.1 International Intergenerational Network of Centers (IINC)

In recent years, several, if not many, tertiary institutions have created such academic centers in environmental and sustainability education. These institutes, within such larger universities, practice, promote, and research transformative education towards cultures of sustainability. Recognizing the value of such innovative work and keen to share research results, Wangari Maathai, Green Belt Movement; Akpezi Ogbuigwe, United Nations Environment Programme (UNEP); and Peter Blaze Corcoran, Center for Environmental and Sustainability Education Florida Gulf Coast University, convened a series of meetings to advance the notion of creating an international, intergenerational informal network of such higher education centers.

Subsequently, meetings in Florida and Kenya included Heila Lotz-Sisitka, Environmental Research Center, Rhodes University and Mahesh Pradhan, UNEP. Other centers were invited to join to expand the circle of participation of a small network of sister centers which promote strong sustainability as advanced by declarations of the United Nations including Agenda 21, the Decade of Education for Sustainable Development, and the Rio+20 Treaty, and by civil society initiatives such as the Earth Charter. The network of centers was launched at the World Environmental Education Congress in Marrakech, Morocco on June 12, 2013.

Individual centers have long promoted the mainstreaming of sustainability in home institutions, in higher education, and in the larger culture. One purpose of the proposed network is to report how individual centers operate at the leading edge of sustainability—to document how centers practice sustainability in their home institutions and communities. Centers strengthen the infusion of sustainability in universities. Centers are able to develop programs for students, connect the university to other institutions, work with government, and involve industry. They are a platform for interdisciplinary knowledge creation. They feed ideas into a university that it is not able to produce on its own.

Academic centers have long been involved in partnerships and collaborative research projects, but to the authors' knowledge there has been little research on their role in education for sustainable development. For example, the network will address the following questions: What is the level and quality of activity at innovative centers in higher education? How do centers serve the purpose of pushing their own home universities toward strong commitments to sustainability? In what ways do centers act as an engine of cultural innovation? How are centers able to build new forms of campus-community scholarship?

This "strategy for transformation", the thesis of the initiative, is that the network can build on the proven success of centers in institutionalizing learning and leadership for sustainability by collaborating on research, scholarship, and action in the context of innovative approaches to mainstreaming environmental and sustainability education. The network promotes collaboration among sister centers across the globe and to expand our vision of strong sustainability to other centers and institutions; thus, it is an international network.

Further, intergenerational learning is critical to any transformation in higher education and to any "sector-wide learning process". The network, therefore, promotes intergenerational collaboration in research and activities. As an example, the IINC has completed an edited volume *Intergenerational Learning and Transformative Leadership for Sustainable Futures* (Corcoran and Hollingshead 2014) that includes these topics. The network launched the book and convened a meeting of member centers at the UN World Conference on Education for Sustainable Development in November 2014 in Nagoya, Japan. A follow up meeting was convened at the World Environmental Education Conference in Gothenburg, in June 2015.

4.2 Envisioning Futures for Environmental and Sustainability Education

The network has also nearly completed another edited volume, *Envisioning Futures for Environmental and Sustainability Education* (Corcoran and Weakland 2017) that invites educational practitioners and theorists to speculate on—and craft visions for—the future of environmental and sustainability education. It explores what educational methods and practices might exist on the horizon, waiting for discovery and implementation. The volume will present contributions that leverage speculative inquiry to imagine how nascent scientific, technological, social, and ecological developments might perturb, disrupt, and/or transform the field of environmental education.

Likewise, the project also mobilizes such thinking to extend earlier lines of related inquiry within the field, such as "backcasting" (Holmberg and Robert 2000), or that chart points of contact between emerging modes of speculative thought and the field's own longstanding concern with ecological futurity. In asking these questions the editors are inspired by thinkers within fields such as design, architecture, and computer science. These disciplines have recently initiated discussions concerning how critical speculation might help practitioners challenge ingrained disciplinary assumptions. For example, speculative design (Dunne and Raby 2011), architecture fiction (Gadanho 2009; Lally 2014), and science fiction prototyping (Johnson 2011) harness science fiction's capacity to explore possible futures through extrapolating elements of our contemporary moment into imaginary worlds.

At a time of increasing local and global challenges and complexity, the project explores the intersection of education, sustainability, and emerging modes of speculative inquiry concerning alternative futures to those of our current unsustainable trajectory. This book will likewise share the creative and innovative contributions that academic centers, networks, and programs are making to advance strong sustainability in education, especially in higher education. It will be the fifth in a series on the United Nations Decade of Education for Sustainable Development (2005–2014) published by Wageningen Academic Publishers. Previous volumes in the series have addressed social learning, young people's participation in

sustainable development (Corcoran and Osano 2009) learning for sustainability in times of accelerating change, and intergenerational learning and transformative leadership for sustainable futures. Each of these efforts has explored educational theories and practices necessary to construct a sustainable future. This volume builds on the topics of previous books by placing the concept of the *future* itself under critical investigation, asking questions such as "whose future?" and "through what intellectual and embodied processes can we create useful knowledge about likely, possible, and desirable futures?" Specifically, *Envisioning Futures for Environmental and Sustainability Education* explores how imagining, writing, designing, and building alternative futures might propel environmental education in new directions.

The editors have encouraged intergenerational and interdisciplinary collaboration in authorship and innovative approaches, if possible, such as the dialogical development of chapters with students. Previous volumes within the United Nations Decade of Education for Sustainable Development (UNDESD) series have responded to the complexity of environmental education in our contemporary moment with concepts such as social learning, intergenerational learning, and transformative leadership for sustainable futures. *Envisioning Futures for Environmental and Sustainability Education* builds on this earlier work—as well as the work of others. It seeks to foster modes of intellectual engagement with ecological futures in the Anthropocene; to develop resilient, adaptable pedagogies as a hedge against future ecological uncertainties; and to spark discussion concerning how futures thinking can generate theoretical and applied innovations within the field.

5 Conclusions: Academic Centers and the United Nations Sustainable Development Goals (SDGs)

Initiatives such as the International Intergenerational Network of Centers and the *Envisioning Futures* project illustrate how university centers can bring together an array of stakeholders in mapping futures for environmental and sustainability education. This work includes tracing new trajectories for theoretical work within the field, situating new knowledge(s) within the space of university campuses and infrastructures, as well as collaborating with community and regional partners.

More broadly, the achievement of truly sustainable development requires a re-orientation of social and economic systems. Enabling the integration needed for the SDG framework to contribute meaningfully to SD will require the full participation of people from all walks of life, all generations, and across a range of sectors. Such transformative social change can potentially be driven by the SDGs. However, this will require adequate social change strategies to be embedded in the SDG policy goals and interventions. One of the most systemically constituted social change strategies used by societies is education and training. Evidence from the UN Decade on Education for Sustainable Development shows clearly that education is an important process for strengthening knowledge, values, and ethics for social

participation in sustainable development processes and actions (UNESCO 2014a). Evidence being produced out of the earth system and environmental sciences suggests that sustainable development learning and action should be constituted within an understanding of earth systems boundaries and the intimate link that exists between people and the environment in social-ecological systems.

Giving attention to education and training within all of the SDGs, and giving attention to sustainable development within the Education Goal in the SDGs (Goal 4) becomes specially important as education and training systems are the first arena for engagement with sustainable development amongst youth, and as such it has an important role to play in facilitating participation in green economies and creating opportunities for sustainable development leadership (International Council for Science and International Social Science Council 2015). Higher education and technical education and training systems need to re-orient research and teaching practices to fast-track engagement with the SDGs. At the same time, basic education should provide core competences, foundational knowledge, and values and skills for a more sustainable future. Wider community and social learning processes are urgently needed for orienting towards more sustainable lifestyles and livelihood choices and actions (Corcoran and Lotz-Sisitka 2015).

The SDGs provide a vision of education for sustainable development. These challenges involve both the production of and engagement with the complex new concepts, forms of knowledge, ethics, and values. There is also need to consolidate and deepen engagement with 'strong sustainability'. This requires recognition of the integral relationship that exists among society-economy-environment, and this integrated concept should be visible in all education and training systems worldwide. There is a recognized urgency for enhanced uptake of new knowledge into social and technological systems for sustainable development governance and practice. All social mechanisms, including education and training systems need to be involved in this process. University centers in environmental and sustainability education can be catalysts for this process in higher education. University research centers convene intergenerational stakeholders in the collaborative process of envisioning sustainable futures—as well as futures for sustainability education. They can do this across disciplines, as well as inside and outside of formal educational settings. This work is critically important in order to accomplish the transformation of attitudes, values, and behaviors necessary to realize ambitious international sustainability projects such as the SDGs.

References

Corcoran, P. B., & Hollingshead, B. P. (Eds.). (2014). *Intergenerational learning and transformative leadership for sustainable futures*. Wageningen, the Netherlands: Wageningen Academic Publishers.

Corcoran, P. B., & Lotz-Sisitka, H. (2015). *Integrating education and training into the United Nations Sustainable Development Goals*. Unpublished Draft for United Nations Environment Programme, May 2015.

Corcoran, P. B., & Osano, P. M. (Eds.). (2009). *Young people, education, and sustainable development: Exploring principles, perspectives, and praxis*. Wageningen, The Netherlands: Wageningen Academic Publishers.

Corcoran, P. B., & Weakland, J. (Eds.). (2017). *Envisioning futures for environmental and sustainability education*. Wageningen, The Netherlands: Wageningen Academic Publishers.

Dunne, A., & Raby, F. (2011). *Speculative everything: Design, fiction, and social dreaming*. Cambridge, MA: MIT.

Earth Charter International. (2000). The Earth Charter. Earth Charter International.

Gadanho, P. (Ed.). (2009). *Beyond No.1—Scenarios and speculations: Short Stories on the post-contemporary*. Amsterdam: Sun.

Gardiner, S. (2003). The pure intergenerational problem. *Monist, 86*(3), 481–500.

Hansen, J., Sato, M., Hearty, P., Ruedy, R., Kelley, M., Masson-Delmotte, V., et al. (2015). Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modeling, and modern observations that 2 °C global warming is highly dangerous. *Atmospheric Chemistry and Physics Discussions, 15*(14), 20059–20179.

Hollingshead, B. P., Weakland, J. P., & Corcoran, P. B. (2014). To walk together: Intergenerational learning and transformative leadership. In P. B. Corcoran &B. P. Hollingshead (Eds.), *Intergenerational learning and transformative leadership for sustainable futures* (pp. 21–36). Wageningen: Wageningen Academic Publishers.

Holmberg, J., & Robert, K. H. (2000). Backcasting—A framework for strategic planning. *International Journal of Sustainable Development and World Ecology, 7*(4), 291–308.

International Council for Science and International Social Science Council. (2015). *International Council of Scientific Unions (ICSU) report, review of targets for the sustainable development goals: the science perspective*. Paris: International Council for Science.

Johnson, B. D. (2011). *Science fiction prototyping: Designing the future with science fiction*. San Rafael, CA: Morgan & Claypool.

Lally, S. (2014). *The air from other planets: A brief history of the architecture to come*. Baden: Lars Muller.

Nixon, R. (2011). *Slow violence and the environmentalism of the poor*. Cambridge, MA: Harvard University Press.

Rawls, J. (2001). *Justice as fairness*. Cambridge, MA: Harvard University Press.

United Nations. (2012). *The future we want: Outcome document adopted at Rio+20*. Available at http://www.uncsd2012.org/content/documents/727The%20Future%20We%20Want%2019%20June%201230pm.pdf. Last accessed March 21, 2016.

United Nations. (2015). *Sustainable development goals*. Available at http://www.un.org/sustainabledevelopment/sustainable-development-goals/. Last accessed March 21, 2016.

UNCED. (1992). *Rio declaration on environment and development* (vol. I, Annex I). New York: United Nations. UN Doc. A/CONF.151/26.

UNCED. (1993). *Agenda 21: Programme of action for sustainable development*. New York: United Nations.

United Nations Conference on the Human Environment. (1972). *Declaration of the United Nations Conference on the Human Environment*. New York: United Nations. UN Doc. A/CONF.48/14.

UNESCO. (2014a). *Sustainable development begins with education: How education can contribute to the proposed post 2015 goals*. Paris: UNESCO.

UNESCO. (2014b). *UNESCO roadmap for implementing the global action programme on education for sustainable development*. Paris: UNESCO.

United Nations General Assembly. (2013). *Intergenerational solidarity and the needs of future generations: Report of the Secretary-General*. New York: United Nations. UN Doc A/68/322.

United Nations General Assembly. (2015). *Transforming our world: the 2030 agenda for sustainable development*. New York: United Nations. UN Doc A/RES/70/1.

United Nations World Summit on Sustainable Development. (2002). *Johannesburg declaration on sustainable development*. New York: United Nations. UN Doc. A/CONF.199/20.

Wals, A., & Corcoran, P. B. (Eds.). (2012). *Learning for sustainability in times of accelerating change*. Wageningen, The Netherlands: Wageningen Academic Publishers.
World Commission on Environment and Development. (1987). *Our common future*. Oxford: Oxford University Press.

Author Biographies

Peter Blaze Corcoran is Professor of Environmental Studies and Environmental Education at Florida Gulf Coast University where he serves as Director of the Center for Environmental and Sustainability Education. In 2013, Corcoran was awarded a Fulbright Fellowship to work with the Wangari Maathai Institute for Peace and Environmental Studies at the University of Nairobi. Corcoran is on the Steering Committee of the Global Universities Partnership for Environment and Sustainability at the United Nations Environment Programme, where he recently completed a year of policy consulting. He is a Senior Advisor to Earth Charter International and a Senior Fellow with the US Partnership for Education for Sustainable Development. He served as a member of the UNESCO Reference Group for the United Nations Decade of Education for Sustainable Development from 2005 to 2014. He is Past President of the North American Association for Environmental Education. Corcoran is a visiting academic and consultant at universities in Fiji, Malaysia, Australia, and South Africa.

Joseph Weakland is a Marion L. Brittain Postdoctoral Fellow at the Georgia Institute of Technology and Editorial Associate at the Center for Environmental and Sustainability Education at Florida Gulf Coast University. His research draws on science fictional thought processes in order to explore the rhetorical possibilities opened up by emerging technologies. He is currently editing two scholarly collections, Envisioning Futures for Environmental and Sustainability Education (Wageningen Academic Press, expected 2016), and Rhetorical Speculations: Emerging Technologies and the Future and Potential of Rhetoric (Utah State University Press, under contract). Both of these projects seek modes of anticipatory engagement with education, meaning making, and rhetorical exchange in a socio-ecological world transformed by accelerating technological change.

Brandon P. Hollingshead is an instructor of Interdisciplinary Studies and Civic Engagement at Florida Gulf Coast University, where he was interim director of the Center for Environmental and Sustainability Education in 2014–2015. His academic and teaching interests are in rhetoric of sustainability, humanities and sustainability, service-learning, and civic engagement. Hollingshead's masters thesis from the University of Utah was on "Crafting Principles for Sustainable Development: Rhetorical Negotiations in the Drafting of the Earth Charter and Johannesburg Declaration on Sustainable Development." He has published and presented on topics connected to youth participation in sustainable development, community-engaged scholarship, and ethical dimensions of sustainability in higher education, including his book on Intergenerational Learning and Transformative Leadership for Sustainable Futures (Wageningen Academic Publishers, 2014).

Transnational Dialogues for Sustainability Research in Early Childhood Education: A Model for Building Capacity for ESD in Universities?

Sherridan Emery, Julie M. Davis, Barbara Maria Sageidet, Nicky Hirst, Diane Boyd and Jamison K. Browder

Abstract

Early childhood education (ECE) within tertiary education has proactively responded to calls to realign preservice teacher education towards more sustainable futures, with Early Childhood Education for Sustainability (ECEfS) developing rapidly as a field of research and practice. An international multi-university initiative that has been a key impetus for ECEfS since 2010 is the *Transnational Dialogues in Research in Early Childhood Education for Sustainability (TND)*. The TND is an international group of experienced and early career researchers that fosters collaborations between individuals and

S. Emery (✉)
Faculty of Education, University of Tasmania, Tasmania, Australia
e-mail: sherridan.emery@utas.edu.au

J.M. Davis
Faculty of Education, Early Childhood, Queensland University of Technology, Brisbane, Australia
e-mail: j.davis@qut.edu.au

B.M. Sageidet
Department of Arts and Education, Institute of Early Childhood Education, University of Stavanger, Stavanger, Norway
e-mail: barbara.sageidet@uis.no

N. Hirst · D. Boyd
School of Education, Liverpool John Moores University, Liverpool, UK
e-mail: n.j.hirst@ljmu.ac.uk

D. Boyd
e-mail: d.j.boyd@ljmu.ac.uk

J.K. Browder
College of Education, University of South Carolina, Columbia, SC, USA
e-mail: jkbrowder@hotmail.com

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_11

groups of researchers, universities and ECE practitioners. In particular, the group aims to build researcher capacity for instigating projects that activate sustainability learning in ECE. This paper reports on three research projects emerging from the third TND and articulates strategies and processes for sustaining ongoing research dialogues in order to promulgate new fields of sustainability research through its collaborations. The authors believe that this kind of dialogic process offers other universities and disciplines a model for embedding sustainability into their processes and structures.

Keywords
Transnational dialogues · Education for sustainability · Early childhood education for sustainability · Curriculum frameworks · Teacher education

1 Introduction

The tertiary education sector has been relatively slow to respond to calls for the reorientation of education towards sustainability, despite being advocated for in numerous key international publications from, for example, the United Nations and the United Nations Educational, Scientific and Cultural Organization (UNESCO), and especially those emanating from the UN Decade of Education for Sustainable Development (DESD) (UNESCO 2005, 2014). This absence is particularly notable within the field of early childhood education and care (ECEC) teacher education and research, despite the likelihood that young children will experience the most significant impacts of unsustainable societies (Davis and Elliott 2014).

The *Transnational Dialogues in Early Childhood Education for Sustainability (TND in* ECEfS), an informal international network of ECEC teacher educators, researchers, and practitioners that developed through the impetus of the DESD, has had significant influence on the emergence of a new productive international research field in sustainability education, spawning new research directions, fostering international conversations about research, and delivering several research publications. This paper, produced collaboratively by researchers and academics engaged in the TND, outlines this initiative, and presents the TND as a model for other multi-university initiatives, with a main purpose of promoting collaborative and practice oriented international research that activates transformative sustainability learning.

First, we present the development of the *Transnational Dialogues* and summarize significant new research growing out of the dialogues. Confident that the TND represents a useful model for the development of other sustainability fields in the tertiary education sector, we conceptualize the TND as an informal decentralized network and share lessons learned about its usefulness for sustaining an international network and community of practice. In revealing the processes,

challenges and successes involved in advancing the TND, this paper encourages the formation of other new international collaborations in sustainability research.

2 What Is the TND in ECEfS?

In 2010, an Australian researcher, Prof. Julie Davis, and Prof. Eva Johansson, a researcher from Norway, initiated the *Transnational Dialogues in Early Childhood Education for Sustainability*. Their intention was to organize a forum whereby international researchers could share multi-national, multi-cultural and multi-disciplinary perspectives and experiences with the overall goal of provoking interest and ideas for future collaborative research, publications, scholarly exchanges and mentoring. The research forum—organized without any external funding apart from basic investments from the host university to cover meals—was planned as a democratic, outcomes-oriented workshop with multiple opportunities for networking between participants. At the time, the field of ECEfS had a very small research base (Davis 2009), and it was decided the workshop should bring together researchers with an interest in ECEfS, even if they did not work directly in the area.

The inaugural TND took place in Stavanger, Norway, in August 2010, as a joint Queensland University of Technology (QUT) and University of Stavanger event. The meeting was held after the World Organization for Early Childhood Education (OMEP) Congress in Sweden, a conference primarily for practitioners, but with an emerging research focus. Fifteen researchers at various stages of their research careers were invited to attend the TND from Australia, New Zealand, Norway and Sweden. This first meeting initiated the TND's ongoing research agenda, which is to proactively investigate ways of knowing and understanding how young children are recognized as, and learn to be, active citizens for sustainability. The action outcomes from this first meeting included a number of ideas to drive collaborative research proposals and papers, a strong desire to continue networking within the ECEfS community, and a submission from participants to the deliberations that preceded the United Nations Rio+20 conference on sustainable development in 2012, which advocated for children's voices and their particular considerations to be integral to global decision-making about sustainability.

TND2 was held in Brisbane in July 2011, in tandem with the 6th World Environmental Education Congress (WEEC), with additional participants from Korea, Japan, and Singapore offering broader international representation, and diverse social-geographical-cultural perspectives on research in ECEfS. Continuing with the focus on building research capacity in ECEfS, action outcomes included new research and writing collaborations, a number of international Visiting Scholar events, several joint research grant applications with international collaborators, and further refereed publications with international co-authors. The most significant output that included participants from both TND1 and TND2 was a research book edited by Davis and Elliott (2014), which has provided a platform for the further

promotion of research in ECEfS, and has already been translated into Korean (Davis and Elliott 2015). The 19 chapters from researchers from nine nations range across three themes: ethics and values, historical and sociocultural contexts, and curriculum and pedagogy.

The third TND returned to Stavanger (July 2015), ahead of the WEEC in Sweden. The increased number of participants and countries represented at this meeting demonstrated the growing interest in ECEfS amongst researchers and added further new perspectives and approaches to the expanding field of ECEfS research. In addition to participants who had attended one or both of the early TNDs, this meeting also included researchers from the United Kingdom, Canada and the United States. Arising from TND3 are five research sub-groups, of which three of these collaborations are profiled in following sections of this paper.

In summary, TND has been a means for building international research capacity in a new area of education for sustainability research, but it is still in its infancy. We acknowledge, for example, that there are currently no voices from First Nations peoples or from Africa or Latin America in the TND and that the research perspectives and methodologies reflect those of the main participants. We do hope and anticipate, however, that these gaps will be addressed in the future and that the TND and other such collaborations will encourage the emergence of new voices and perspectives. Such diversity is vital if the field is to continue to grow, prosper and make an impact.

3 Research Projects Emerging from TND3

Here we outline three of the collaborative international studies that are currently being investigated by TND3 researchers. Each project has been developed by those who expressed interest in the topic, and that emerged from a process of brainstorming begun on the second day of the workshop. Through further inclusive debate, discussion and negotiation, a large number of discrete topics were distilled into five 'researchable' themes or topics.

3.1 Transnational Case Studies of Children's Webs of Connectedness in ECEfS

In this first study, the researchers have a wide range of research experience – from that of a full professor with limited publications in English, a doctoral candidate, and a practicing teacher with a strong interest in ECEfS research who recently commenced doctoral studies. Inoue (2014) asserts that early childhood educators who offer daily learning experiences that embed ecological concepts such as biodiversity, life cycles, and human-nature interdependency have the potential to foster an "ecological worldview" in young children, where interconnections between elements are paramount. She also asserts that understandings of ecological

worldviews vary among educators and centers, regions and countries. This multiplicity of perspectives makes it difficult to generalize what teaching for an ecological worldview might look like in early childhood education. The researchers decided to employ case study design for the research with a focus on how features within local contexts influence educators' pedagogical practices and opportunities for children to develop ecological worldviews.

This research of young children's ecological worldviews has been conducted in three contexts: Australia, Japan, and the United States. Inoue, from Japan, has already researched the development of ecological worldviews in ECE with very young children (Inoue 2014), with this research then taken up by Emery (Australia) and Browder (USA) who in turn conducted cases in their own home countries. Here, these latter two case studies are briefly described.

3.1.1 An Australian Case Study

Conducted in Triabunna on the east coast of Tasmania in southern Australia, this case study explores webs of connectedness (or connections) at an early childhood education (ECE) center located near Great Oyster Bay, a region that is a breeding ground for fairy penguin colonies. As part of the center's ongoing learning program, young children have begun learning about the webs of connections between habitat change and the penguins.

The region's parks and wildlife services (PWS) invited a childcare centre in Triabunna to partner with them in a penguin breeding program in which children from the center built breeding boxes for the penguin colony on nearby Little Christmas Island. As a result of changing seasonal conditions, the habitat on Little Christmas Island has also changed, leading to a decline in the penguin colony and a slowing of their breeding, due to a lack of food for the penguins, as well as ongoing predation. PWS presented this problem to the children at the center and discussed with them how the breeding boxes represent a human-designed adaptation to climate change which supports the survival of the penguin population in this area. Using design plans provided by PWS, the children worked together with the groundsman from the childcare centre to build six timber breeding boxes designed to provide a safe habitat for nesting penguins that the PWS then installed on the small rocky island. The children's connection with the life cycle of the fairy penguins was sustained through ongoing reporting on the progress of the island's penguin population by PWS staff and through ongoing conversations with the children.

By explicitly introducing concepts of interdependencies between humans and nature into the learning program (Inoue 2014), this Australian case study illustrates that early childhood learning can be oriented towards environmental awareness and sustainability. Further, such learning supports the national curriculum outcomes of the *Early Years Learning Framework for Australia* (Department of Education Employment and Workplace Relations (DEEWR) 2009), in particular Outcome 2: "Children are connected with and contribute to their world" (p. 29), which adds additional legitimacy to such learning and teaching.

3.1.2 A United States Case Study

In a South Carolina public school, twenty-two kindergarten children and their teacher engaged in a year-long collaborative inquiry that investigated how an outdoor learning space could provide a context for understanding webs of connectedness.

At the beginning of the school year, the children expressed interest in revitalizing four raised garden beds which were overgrown with weeds and grass. Appreciating the children's initiative and thoughtfulness, the teacher contacted a group of community members to work alongside the class to prepare the garden area for the autumn planting cycle. The community members who included parents, university academics, and nutritionists offered information about seasonal planting and the benefits of eating locally-grown, organic produce.

The autumn harvest was successful, with the children producing a bounty of kale, lettuces, and Georgia collards. Encouraged by their success, the children then planted a spring garden. A local Elder was enlisted to help the children germinate the seeds. The seedlings were placed in the garden plots that had been replenished from a compost heap containing leaves gathered from a poplar tree. During the spring planting cycle, the children were able to observe many butterflies moving fluidly from the garden area to the poplar tree. Their curiosity led to the educator making contact with a local expert (a naturalist at the University of South Carolina) to further their learning about ecological connections.

This United States case study illustrates the power of incorporating hands-on, real-world, place-based learning experiences within formal school structures and processes (Sobel 2005). Teachers who are responsive to children's interests, and are willing to learn alongside them, can promote both academic achievement as well as an ethic of care for the natural environment. As this case shows, community vitality is also enhanced when community members, children, and their educators purposefully weave webs of connectedness. Further, as in the case from Australia, such learning also helps educators to successfully address learning outcomes in the *Head Start Early Learning Outcomes Framework: Ages Birth to Five* (Department of Health and Human Services (DHHS) 2015), and in particular, Goal IT-ATL 6 a "child demonstrates emerging initiative in interactions, experiences, and explorations" (p. 14).

The researchers anticipate that these small-scale transnational case studies will provide some initial opportunities for better understanding concepts such as webs of connectedness and the formation of ecological worldviews across multiple ecosystems and multiple socio-cultural contexts. This resonates with Gruenwald's (2008) ideas of bringing together culturally-sensitive and place-responsive education that focuses on lived experiences of places. The researchers believe there is merit in extending such international perspectives to a wide range of topics to better contribute to global understandings of our shared concerns with sustainability and learning. Higher education institutions have a key role in fostering such research collaborations.

3.2 A Transnational Study of ECEfS Within Early Years Curriculum Frameworks

Early Childhood Education resounds to a rich cacophony of voices (Moss 2015) and has been recognized as a fertile site for discussion around education for sustainability (EfS). Thus, this (re)search hopes to offer an agnostic inquiry into the visibility of language associated with sustainability within early childhood curricula. Members of this research group sought to locate language and awareness of EfS within the early year's curricula in England, *The Early Years Foundation Stage* (Department for Education 2014); Australia, *Early Years Learning Framework for Australia* (DEEWR 2009); the USA, *Head Start Early Learning Outcomes Framework: Ages Birth to Five* (DHHS 2015); Norway, *National Framework Plan for the Content and Tasks of Kindergartens* (Ministry of Education and Research 2011); and Sweden, *Curriculum for the preschool* (National Agency for Education 2010). In order to build on sustainability-related research within early childhood education, these researchers involved in the TND were drawn together to explore early childhood curricula from each of their specific home country perspectives, which will subsequently be used to provoke 'friendly' interrogation of the data.

This (re)search for language associated with ECEfS coexists with the reviewed and newly ratified Sustainable Development Goals (United Nations n.d.). The discourse surrounding EfS will be explored through comparative data analysis of a range of early years' curriculum documentation in international settings, thus contributing to definitions of sustainability as multi-dimensional, rather than acceding to ways of looking at sustainability (and education for sustainability) as singular 'one-size-fits-all' notions regardless of context. Initial scrutiny of the frameworks suggests there may be a lost window of opportunity to explicitly embed the language of EfS in some frameworks. While the research does not claim to be ground breaking, it will seek to remind to practitioners, policy makers and universities that there are many ways of making sense of the world. Paradigms associated with sustainability are often marginalized within teacher education in universities; however early childhood educators have been strong advocates supporting "the foundations of many of their [children's] fundamental attitudes and values" (Siraj-Blatchford et al. 2008, p. 6). Hence, the purpose of this particular research is to advance the reframing of early childhood curricula so that interrogation of each national curriculum framework may better support and influence thinking about sustainability and EfS more broadly within Higher Education, particularly in teacher education.

The methodology for this sub-program of the TND embraces a collaborative inquiry approach in the hope that international collaboration will "demystify and democratize the process of constructing knowledge" (Bray et al. 2000, p. 19) related to the different curriculum requirements for ECE across international contexts. Explorations, to date, include a comparative analysis of the language about sustainability and EfS embedded in each framework, and has been captured in the form of a comparative table using the three well-articulated pillars of sustainable

development - Cultural Social, Economic, and Environmental (Arlemalm-Hagser and Davis 2014; Siraj-Blatchford et al. 2008).

The researchers plan to advance this research focus through working within, and beyond, their sub-groups to network, socialize and collaborate with other experienced, mid and early career researchers, with the wider goal of developing an international community of inquiry in Higher Education around ECEfS. The idea of early childhood as a site for philosophic discussion and agentic change is often noted with caution, for example: by Moss (2015), not to see discussion as a magic potion; by Dahlberg and Moss (2005) not to position children as redemptive agents; by Davis and Elliott (2014) who caution against the saviours for sustainability discourse; and by Siraj-Blatchford (2008) not to program children as the ones to solve our present sustainabilty problems. Through this project the researchers aim to reframe early childhood curricula, in order to locate sustainability as occurring within a framework of social practices, and under the gaze of culture and institutions (Foucault 1998). As early childhood education is often positioned by governments as a form of social contract to offer a firm foundation for future education and employment, the relevance of systems thinking (Davis and Ferreira 2015) also supports the idea of system-wide transformation where the processes of interpretation and construction ultimately transfer to the dialogue with students in higher education who will, in turn it is hoped, become agentic in their work with children and the wider context. These researchers believe there are opportunities to extend such an examination of curriculum policy to the Higher Education sector more broadly. Interrogating curriculum policy offers a wealth of opportunities for discussion around local pedagogic practices as regimes of truth (Foucault 1998). These truths may help us 'do' pedagogies differently, including the identification of multiple ways of working with curricula guidance whilst holding onto advocacy as a key principle.

3.3 Researching ECEfS in Early Childhood Preservice Teacher Education

This research program arising from the TND3 addresses the gap in research about the 'state of play' of sustainability and EfS in early childhood preservice teacher education in international contexts. The general research question being investigated is: 'How is sustainability and EfS/ESD constructed and practised in early childhood preservice teacher education programs?' The study dovetails with the UNESCO *Roadmap for Implementing the Global Action Programme on ESD*, Priority Action Area 3 'Building capacities of educators and trainers' that emphasizes 'teacher education institutions deliver pre-service and in-service training on ESD', including early childhood teacher education (UNESCO 2014).

The researchers in this sub-group are from Australia, New Zealand, Sweden, Norway, and Korea although we anticipate that others will join the team as the project expands. Research to date identifies that the inclusion of EfS in teacher education courses has generally been patchy and often the result of committed

individuals rather than embedded systemically (Stevenson et al. 2014). In the case of Australia, this is despite sustainability being identified as a cross-curriculum priority in the national school curriculum (Australian Curriculum Assessment and Reporting Authority [ACARA] 2010) that should be embedded into all learning areas of education for students from Foundation to Year 10. Such increased emphasis on sustainability presents challenges for pre-service teacher education (Effeney and Davis 2013), and perhaps even more so in early childhood teacher education because of the lack of specialist teacher educators who have an interest in such matters.

This research is at the beginning of a five-phase program expected to stretch over several years.

1. A systemic review on international literature will be conducted. A systemic review helps propose a future research agenda when the way forward is unclear or existing agendas have failed to address an issue (Hemingway and Brereton 2009). This draws on work in the emerging field of systematic reviews.
2. Critical policy analysis (Taylor 1997) of university top level strategies, teacher accrediting bodies, curriculum documents, quality indicators for ECE etc. will be conducted to identify potential policy drivers to support a focus on EfS in teacher education programs.
3. An audit of online early childhood teacher education course materials looking for references to sustainability and EfS has commenced.
4. International case studies will be conducted in the 'home' countries of participants to identify enablers and constraints to embedding of EfS within preservice early childhood teacher education programs.
5. The creation of 'communities of practice' (CoP), a broad descriptor characterizing participants coming together – either/both face to face or electronically - to engage with shared topics, issues and challenges (Cox 2005; Wenger et al. 2002), will be encouraged. We see CoPs arising at the level of individual institutions, at the national level of ECE teacher educators, and internationally, where they have the potential to address the increasingly global nature of EfS facilitation by linking people and organizations to local and global sustainability goals.

At the time of writing, the study has commenced in Australia with an audit of online early childhood teacher education course materials being the starting point. Initial findings identify few instances of explicit reference to sustainability or EfS as part of course outlines or offerings. Once the method has been trialled, research participants from partner countries in New Zealand, Sweden, Norway, and Korea will be invited to conduct similar audits in their own countries.

Although this research program is focused on EfS/ESD within early childhood teacher education, it is anticipated that it will offer a model—in full or in part—across a range of faculties and disciplines within a university, with transnational possibilities for connecting researchers, academics and managers with an interest in sustainability and education for sustainability. This is because the project is

process-oriented rather than content-focused, aimed at creating the conditions for broad systemic change within universities.

4 Lessons Learned from the TND

We believe there are a number of practical lessons that can be drawn from considering the growth of the TND and its success in generating new international collaborations in the field of sustainability research. First, is the importance of forming and nurturing personal relationships amongst fellow researchers in your field especially if yours is a small, start-up field of research. The inaugural TND in 2010 brought together ECEfS researchers, most of whom were colleagues, compatriots, or had in some way dialogued—perhaps at a conference, perhaps through online exchanges—with the two academics who organized the initial event. The organizers and early participants drew upon informal networks to invite not only researchers who were currently working on ECEfS projects, but also those whom they knew had expressed interest in the field, without having directly worked in it. These personal connections between researchers have helped to expand both the TND and the field of ECEfS research as participants continue to build and strengthen their international connections through continuing networking and professional collaborations. Building a critical mass is essential!

It is important to note, however, that while information technologies have allowed participants to maintain good virtual communication with the organizers and each other, face-to-face interactions remain vitally important. This is why the TND remains a physical event, allowing participants to meet, eat meals together, catch trains and planes together, discuss our research in open and supportive ways, and to share our varied multi-national and multi-disciplinary perspectives on issues concerning ECEfS. Further, despite the transnational nature of the TND, we have found that access to external funds to support the events has not been necessary as researchers have been willing to either self-fund or have been able to convince their universities to contribute some resources to enable them, individually, to attend. Piggybacking off other major research events, such as international conferences, also enables participants to defray some of their costs.

Additionally, the TND as a network means that all the participants have ownership of the processes and the outcomes. While there are is a small number of key participants who keep the network ‘alive’, and take some responsibility for sending updates and providing motivation, it is the participants themselves who collaboratively developed the various research agendas and determined what research themes to pursue. This democratic approach has reaped dividends as the list and quality of research outputs demonstrate.

We have found that one of the TND’s strengths is that it is outcomes-focused. The emphasis on producing research outcomes such as refereed papers, books and book chapters, and research grant applications, has allowed the TND to maintain momentum between face-to-face meetings. Additionally, TND participants have

engaged in Visiting Scholar programs between universities, been offered opportunities to present international keynote addresses, served as thesis examiners for national and international TND colleagues, and a myriad other academic tasks that enable individual researchers to build their research careers. Collectively, all these activities have supported the ongoing development of ECEfS as a rich field of research that is reshaping how people see early childhood education and its contribution to sustainability.

5 Conclusion

In this paper, we offered the example of the Transnational Dialogues in Early Childhood Education for Sustainability as a means for promoting collaborative research and reorienting the tertiary education sector towards sustainability, with particular reference to the the field of early childhood education. Ongoing research dialogues have sustained this informal decentralized network of early childhood education for sustainability researchers that originated in the first international meeting of participants in 2010. These dialogues have allowed a growing band of sustainability-focused researchers, from an expanding list of countries, to network and collaborate with like-minded colleagues. This international community of practice has served as the stimulus for a range of outputs that reflect the positive interactions that can result from bringing together multi-national and multi-disciplinary perspectives and experiences. Some practical implications have included education for sustainability becoming a research theme in the University of Stavanger's annual PhD program in early childhood education in Norway. Meanwhile in England there has been a recent revalidation of an early childhood related degree where the programme is grounded in both local and global early childhood realities and framed with clear reference to both UN and UK policy and programmes.

Finally, we have written this paper in the same spirit as the TND itself—it is a collaboration across countries and contexts, bringing together researchers at various levels of experience and expertise to encourage the promulgation of new fields of sustainability research. It is hoped that the dialogic processes of the TND may offer a productive model for other groups and sectors to draw upon in embedding sustainability into their higher education environments.

References

Arlemalm-Hagser, E., & Davis, J. (2014). Examining the rhetoric: A comparison of how sustainability and young children's participation and agency are framed in Australian and Swedish early childhood education curricula. *Contemporary Issues in Early Childhood, 15*(3), 231–244.

Australian Curriculum, Assessment and Reporting Authority. (2010). *Cross-curriculum priorities: Sustainability*, Sydney, viewed 26 March 2016. http://www.australiancurriculum.edu.au/CrossCurriculumPriorities/Sustainability

Bray, J., Lee, J., Smith, L., & Yorks, L. (2000). *Collaborative inquiry in practice: Action, reflection and making meaning*. London: Sage.

Cox, A. (2005). What are communities of practice? A comparative review of four seminal works. *Journal of Information Science, 1*(6), 527–540.

Dahlberg, G., & Moss, P. (2005). *Ethics and politics in early childhood education*. London: Routledge Falmer.

Davis, J. (2009). Revealing the research 'hole' of early childhood education for sustainability: A preliminary survey of the literature. *Environmental Education Research, 15*(2), 227–241.

Davis, J., & Elliott, S. (Eds.). (2014). *Research in early childhood education for sustainability: International perspectives and provocations,* London: Routledge.

Davis, J., & Elliott, S. (Eds.). (2015). *Research in early childhood for sustainability: International perspectives and provocations* (Trans. O. Ji, M. Huh & E. Baik). Seoul: Changjisa.

Davis, J., & Ferreira, J. (2015). Using research and a systems approach to mainstream change in early childhood education for sustainability. In J. Davis (Ed.), *Young children and the environment: Early education for sustainability* (pp. 320–355). Port Melbourne: Cambridge University Press.

Department for Education. (2014). *Statutory framework for the early years foundation stage.* London.

Department of Education Employment and Workplace Relations. (2009). *Belonging, being and becoming: The early years learning framework for Australia*. Canberra: Commonwealth of Australia.

Department of Health and Human Services. (2015). *Head start early learning outcomes framework,* Washington. Retrieved from http://eclkc.ohs.acf.hhs.gov/hslc/hs/sr/approach/pdf/ohs-framework.pdf

Effeney, G., & Davis, J. (2013). Education for sustainability: A case study of pre-service primary teachers' knowledge and efficacy. *Australian Journal of Teacher Education, 38*(5), 32–46.

Foucault, M. (1998). *The will to knowledge*. London: Penguin.

Gruenwald, D. (2008). The best of both worlds: A critical pedagogy of place. *Environmental Education Research, 14*(3), 308–324.

Hemingway, P., & Brereton, N. (2009). What is a systematic review? (2nd Ed.). Hayward Medical Communications. *What is…? series*. [online]. Retrieved from http://www.medicine.ox.ac.uk/bandolier/painres/download/whatis/Syst-review.pdf

Inoue, M. (2014). Perspectives on early childhood environmental education in Japan: Rethinking for a sustainable society. In J. Davis & S. Elliott (Eds.), *Research in early childhood for sustainability: International perspectives and provocations* (pp. 87– 95). London: Routledge.

Moss, P. (2015). There are alternatives! Contestation and hope in early childhood Education. *Global Studies of Childhood, 5*(3), 226 –238.

National Agency for Education. (2010). *Curriculum for the preschool.* Stockholm.

Siraj-Blatchford, J. (2008). The implications of early understandings of inequality, science and technology for the development of sustainable societies. In I. Pramling Samuelsson & Y. Kaga (Eds.), *The Contribution of early childhood education to a sustainable society* (pp. 67– 72). Paris: UNESCO.

Siraj-Blatchford, J., Smith, K., & Pramling Samuelsson, I. (2008). *Education for sustainable development.* Organisation Mondiale Pour l'Education Prescolaire (OMEP), Retrieved from http://www.327matters.org/Docs/ESD%20Book%20Master.pdf

Sobel, D. (2005). *Place-based education: Connecting classrooms and communities*. Massachusetts: The Orion Society.

Stevenson, B., Davis, J., Ferreira, J., & Evans, N. (2014). *A state-wide systems approach to embedding the learning and teaching of sustainability in teacher education.* Canberra: Office of Learning and Teaching, Australian Government Department of Education.

Taylor, S. (1997). Critical policy analysis: Exploring contexts, texts and consequence. *Discourse: Studies in the Cultural Politics of Education, 18*(1), 23–34.

United Nations Educational, Scientific and Cultural Organization [UNESCO]. (2005). *UN decade of education for sustainable development*, Paris.
United Nations Educational, Scientific and Cultural Organization. (2014). *Roadmap for implementing the global action programme on education for sustainable development,* Paris. Retrieved from http://unesdoc.unesco.org/images/0023/002305/230514e.pdf
United Nations. (n.d.). *Sustainable development goals.* Retrieved from https://sustainabledevelopment.un.org/sdgs
Wenger, E., McDermott, R., & Snyder, W. (2002). *Cultivating communities of practice: Guide to managing knowledge*, Cambridge, USA: Harvard Business School Press.

Authors Biography

Sherridan Emery is a PhD candidate in the Faculty of Education at the University of Tasmania and Programs Coordinator for Awards and Grants in the Tasmanian Institute of Learning and Teaching based within the university. Her PhD project explores teachers' perspectives of cultural wellbeing in classroom communities. Sherridan is an active researcher across numerous school and community-based research collaborations at the University of Tasmania focusing on the intersections between wellbeing, the arts and sustainability.

Professor Julie M. Davis is based in the School of Early Childhood at Queensland University of Technology. Her special areas of interest are early childhood education for sustainability and embedding sustainability into teacher education. She is the editor of the internationally-successful text book for preservice early childhood teacher education, "Young Children and the Environment: Early Education for Sustainability" (Cambridge 2010, 2015), and co-editor of the research text 'Research in Early childhood Education for Sustainability: International Perspectives and Provocations' (Routledge 2014). She has co-authored a number of reports, chapters and papers on a 10 year project on teacher education and sustainability in Australia.

Associate Professor Barbara Maria Sageidet researches and teaches at the Institute of Early Childhood Education, University of Stavanger, Norway. Her background and PhD was related to botany, ecology, paleoecology and soil sciences. Since 2007 she has worked in the field of early childhood education with a research focus on sustainability, science education, and inquiry learning in the kindergarten.

Nicky Hirst is the Programme leader for the undergraduate BAH Early Childhood Studies degree at Liverpool John Moores University. She worked in the early years sector for over fifteen years before moving into higher education where she has taught extensively within early childhood degree programs and mentoring students on pathways for Early Years Professional Status. Nicky is a member of the Early Childhood Studies degree forum, Early Education and OMEP. Her qualifications include an Early Childhood Studies BA Hons from Manchester Metropolitan University and a Masters degree in Academic Practice in Higher Education. Nicky is currently working towards PhD by publication.

Diane Boyd is a senior lecturer at Liverpool John Moores University in the department of education teaching across Early Childhood studies, Education Studies and Early Years. Her qualifications include a B.Ed. (Honours) in Primary Education and drama, an M.A. in Early Years Education, and Certificates of Advanced Studies in Early Years and in Mentoring. Diane was a classroom teacher in Early Years for nearly twenty years and has co- authored a book Understanding Early Years across the UK: Comparing practice in England, Northern Ireland, Scotland and Wales. She is leading a task force in England on embedding sustainable practice into

the early years nationally with Eco schools England and OMEP UK and is currently working on her PHD by publication.

Jamison K. Browder is a doctoral candidate at the University of South Carolina. He is also a full-time early childhood practitioner working with children aged four to six years old. His research interests include outdoor play, early childhood education for sustainability in public school settings and forest kindergartens. Most importantly, Mr. Browder and his wife, Jennifer, are the proud parents of three wonderful children: Will, Miles and Townsend.

Evolution of an Interactive Online Magazine for Students, Academics and Expert Practitioners, to Engage Students from Multiple Disciplines in Education for Sustainable Development (ESD)

Kay Emblen-Perry, Sian Evans, Katy Boom, Wendy Corbett and Lorraine Weaver

Abstract

Urgency to embed awareness of sustainability principles and practice across society, and need for digital literacy and advocacy for sustainability are reshaping ESD. These, together with developments in learning and teaching, demand new tools to support implementation of project-based learning and more interactive approaches. This investigation explores the evolution of susthingsout.com, an online magazine for students, academics and expert practitioners, developed by the University of Worcester. This comprises two parts; the first, a private site specifically for students involved in sustainability learning on-campus; the second, an open-access site developed to deliver sustainability information and good practice across campus, community and not-for-profit and commercial organisations. This paper involves only the private site i.e. the equivalent of an in-house VLE specifically designed to support the teaching of sustainability to multi-disciplinary first and second year undergraduate students.

All authors are from the University of Worcester.

K. Emblen-Perry (✉) · S. Evans · K. Boom · W. Corbett · L. Weaver
Worcester Business School, Institute for Science and the Environment, Sustainability Department, Institute for Humanities and Creative Arts, University of Worcester, Henwick Grove WR2 6AJ, UK
e-mail: k.emblenperry@worc.ac.uk

S. Evans
e-mail: sian.evans@worc.ac.uk

K. Boom
e-mail: k.boom@worc.ac.uk

W. Corbett
e-mail: w.corbett@worc.ac.uk

L. Weaver
e-mail: l.weaver@worc.ac.uk

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_12

It reports on the progress of the VLE, following three years of use and initial improvements, in terms of the student support and engagement, as well as considering the practical issues affecting these. The results fall into four categories of pedagogical, operational, cultural and external factors, which are synthesised to capture and share emerging knowledge of good practice offering insights to other developers of online sustainability materials.

Keywords
Education for sustainable development (ESD) · Digital learning platform · Innovative pedagogy · Learning community · Blackboard · Social media

1 Introduction

The urgent need to embed sustainability principles and practice across society is recognised by governments, private sector, civil society and the general public (United Nations 2015). The potential of higher education institutions to 'drive global change' and make substantial contributions to sustainable development (SD) through their teaching, learning and research, the sustainability of their campuses and their influence on wider communities is also well documented (HEFCE 2013; Higher Education Academy 2014). In response to this, the University of Worcester's (UK) strategic plan incorporated the statement: 'We promote sustainable development and active community engagement. We have an important role in generating and applying knowledge for public benefit' (University of Worcester, 2013). To ensure this is accomplished the University has undertaken to embed sustainability across the curriculum, campus and the community. This is facilitated using 'susthingsout.com' which is embedded in the University's cross-institute elective programme on sustainability (available to all undergraduate students).

The online magazine, susthingsout.com, incorporates public and private sites. The public site facilitates multi-disciplinary collaboration, online learning, sharing of good practice, and co-creation of knowledge for SD amongst a wide variety of stakeholders (authors, academics, experts, commercial and not-for-profit organisations and community groups). Students are encouraged to use this as a live learning resource. The private site, on which this evaluative study concentrates, is a digital learning platform comprising students' pages (similar to other virtual learning environments (VLE) employed in Higher Education). This will be referred to as the VLE. It offers learning opportunities with private, secure, online collaborative space for use by tutors and students and facilitates e-portfolio, feedback mechanism and assessment functionality. Students benefit considerably from this blended learning strategy which uses these multiple methods to deliver deeper sustainability learning. (Demian and Morrice 2012; Lyndon and Hale 2014). It is the combination of public

and private sites and co-creation and cross collaboration, including input from expert practitioners, which sets this apart from other digital learning platforms. This innovative pedagogy meets the step change as advocated by the Higher Education Academy who state, 'Progress in ESD requires the reorientation of entire educational systems, making large-scale shifts in curriculum priorities, policy and practice' (2014).

The VLE promotes competencies required for ESD such as critical thinking, imagining future scenarios and making decisions in a collaborative way which equips students with the knowledge and understanding, skills and attributes needed to work and live in a way that safeguards environmental, social and economic wellbeing (Higher Education Academy 2014). It incorporates participatory teaching and learning methods that equip learners with the knowledge to take action for sustainable development.

This use of Technology Enhanced Learning in ESD has been gaining momentum over the past decade (Raghubansie et al. 2014). Although the VLE is unique in its vision for integrating learning and debate across curriculum, campus and community, other related studies have been drawn upon to inform its ESD content and technical design and ongoing development (Li and Pak, 2010; Dengler 2008; Isacsson and Gretzel, 2011; Johnson et al., 2014; Sibbel 2009; Van Wynsberghe and Andruske 2007). Ragubansie et al. (2014) discuss the aims and early development of the project in further detail and present a comprehensive discussion of the literature that informed the original project.

This paper reports feedback following three years of use, including initial improvements, in terms of student support and engagement and considers practical issues of these. Findings are then synthesised to capture and share emerging knowledge of good practice offering insights to other developers of online sustainability materials.

2 Methodology

This research presents a case study approach and documents the ongoing research into the evolution of the VLE. It combines information from four focus groups held with Level 4 and Level 5 elective students and staff teaching team reflections. Students with a range of experience with the VLE were recruited for the focus group, hosted by an independent facilitator, to ensure that views of both new users and frequent 'posters' were established. In the discussion of findings below, students' level of study is identified by the abbreviations L4 or L5 and 'n' or 'e' to reflect novice (n) or established user (e) is added to the participant reference to indicate their level of experience.

The non-positivist learners' voice research approach collected qualitative data from participants within focus groups. Morgan and Spanish (1984) advocate using focus groups of non-randomly selected participants to quickly obtain thoughts and experiences of a subject of which the participants have prior knowledge. This

approach was chosen to ensure the focus of the study remained on the experiences of the researched group and to preserve the relationship between the researched and the researchers (Alessandrini 2012), which, through tutor to student feedback and peer support, is a guiding principle of the VLE. This learners' voice research approach is also appropriate for the exploration of complex open-ended systems of ideas and inter-relationships that characterise sustainability and are frequently ethical and moral concepts.

Staff members have contributed their 'reflection-on-action' following the approach proposed by Schön (1987). They have mentally revisited their personal actions and events to gain insights into the development of the VLE.

The analysis of focus group data collected follows the approach proposed by Bertrand et al. (1992), which recommends synthesising the comments of the participants through an inventory of points into a segmentation of key points expressed. This process has been used to identify the key issues that influence the practical development of the VLE and the more complex processes of gaining student support and engagement.

The authors used the 'barriers and pathways' approach used in the Future Fit Framework (Sterling 2012) to highlight drivers and limiting factors that contribute to the success of the VLE following three years of use and initial improvements. This is specifically applied in terms of student support and engagement for using the VLE as a tool for ESD and provides a format for considering the practical issues affecting its development. Learning from the pilot study (Raghubansie et al. 2014) is included where appropriate.

The results have been grouped into four categories: pedagogical, operational, cultural and external factors. These categories exemplify the skills and competencies those responsible for learning and teaching and curriculum development are building into their education practice and policy within ESD and so both the results and discussions are shown below under these headings.

3 Analysis of Data

3.1 Pedagogical Factors

Pedagogic aims from the VLE are to develop deep learning for sustainability, and critical–thinking skills through engaging students in expressing their views, recognising multiple viewpoints, participating in peer-to-peer learning and support, and obtaining tutor-to-student feedback.

One of the key pedagogical factors to emerge from the focus group participants is the development of critical thinking skills with the majority of students expressing their ideas when posting to the VLE and viewing each other's opinions. Through this the VLE appears to be contributing to its aim of developing deep learning for sustainability and critical thinking skills. Deep learning involves analysis of new ideas for understanding and long term retention of concepts

(Houghton, 2004). In addition student learning is enhanced via tutor feedback to develop qualities of resilience, resourcefulness, creativity and systematic thinking to handle the complexities and uncertainty of sustainability (Sterling 2012):

> You…get the feedback from the lecturers and use that to develop your ideas (L4n)

> It helps when you post something you get feedback from your tutor. They will comment on what's good and point you in the right direction of further reading (L4n)

Peer-to-peer learning, where the learners are actively engaged in the learning process (Hutchings et al. 2007), is designed into the VLE to enhance deep learning for sustainability and facilitated through student comments on each other's posts. There is some evidence of the value of this:

> You can see what other people have put so if you're struggling on doing a task you can look at what other people have already done (L4n)

> I like that if I have a problem my other peers can comment and help (L4n)

There is recognition amongst users that it is not as well supported by peers as it could be:

> I think the lecturers comment a lot more than the students. I think we're supposed to comment a lot more (L4n)

The perception that some students value academic feedback more highly than that of their peers emerged from this study. This view is not restricted to the VLE but also occurs in traditional peer assessment (Boud and Molloy 2013) and could undermine tutors' expectations of peer-to-peer learning.

Staff reflections on the VLE consider that the tutors' efficiency in posting comments has created a culture of 'instant' feedback, possibly reflecting students' interaction with social media. Providing timely, detailed and appropriate feedback for all posts is resource intensive and creates an expectation of instant acknowledgement, which may not be sustainable or desirable within the current environment of learning.

As might be expected, with their ongoing use of the VLE, L5e students have some recognition of the opportunity it has to act as a tool for knowledge management and to provide a community of learners to enhance their learning. In contrast a view emerges that L4 students recognise VLE as an informal community for enquiry. They appear to perceive sharing posts as an opportunity to see others' work and to obtain practical help rather than gaining knowledge.

There is some concern that sharing posts may create stress and embarrassment for students and staff.

> I had to re-write something 3 or 4 times because it didn't sound right or I wasn't sure on the spelling. I would prefer it if perhaps just the lecturer could see it (L4n)

> You don't want to come across as you're criticising (L4n)

This anxiety was not common but may be worth highlighting for other developers of online materials for ESD. Despite the audience being "Digital Natives"

(Prensky 2001) who expect technology to help them learn, digital learning platforms may not address the learning needs of all students. One L4n student summed up the feeling towards posting in front of peers:

> I think that in the digital age you have to get used to people posting and viewing your things

As 'Digital Immigrants' (Prensky 2001) staff have similar anxieties about peer observation on posts and digital literacy skills. It was noted amongst the teaching team that confidence in posting and commenting developed with experience and substantial support was required in the early stages.

However, L5e users recognise that there is a spectrum of learning styles within classes and that the VLE offers an opportunity for the more cautious class members to contribute to comments and polls:

> It gives you an opportunity to discuss things which you maybe couldn't in class (L5e)

> Last year, if something was discussed in class which had been controversial, not many people might have given their opinion. Whereas they could go away and think about their argument and then vote on the anonymous poll (L5e)

> If people do not want to voice their opinions in class they can do so online. It's not an issue with us as we're all friends but [good] for someone who didn't know the subject well or was afraid of what people might think (L5e)

From the previous research it became apparent that additional alignment with course content would enhance student engagement. Work was therefore undertaken to facilitate VLE interaction in class through incorporating online posts into assessments. This research indicates that motivation to participate has been improved through these actions but engagement is still driven in part by assessment methodology. L5 students highlighted the motivation that linking the VLE to an assessment gave them:

> Last year we had a reflective blog to summarise the year as our assessment. I could put up part of the blog because we had to critically evaluate some of the talks we were given. So I could write about my view of the talk and then people could respond to my opinion. I could therefore use that response in my portfolio, so I feel like that is my incentive (L5e)

Staff reflections on the VLE also suggest that the quality and amount of information provided influences students' engagement, a view that supports the research findings of Hockings et al. (2008). This study, whilst recognising the students' largely positive response to the VLE, highlights the need to protect the professionalism and integrity of the digital learning tools which support the University's online sustainability presence by closely monitoring and managing the content posted.

3.2 Operational Factors

Operational aims are to encourage student and staff competency in utilising the VLE for ESD. The previous research recognised that the breadth of topics within

sustainability and the complexity of sustainability learning and teaching challenged students' expectations whilst the lack of prescriptive content and definitive answers made students less confident over their participatory competence, particularly in expressing their views on the VLE (Raghubansie et al. 2014). Staff reflection-on-actions has identified that competency with the VLE has subsequently markedly developed including the greater recognition of competencies and skills required by all users. Passwords, full training and operating instructions are now provided in week 1. Staff reflections for this research indicate that this has had a positive impact on student confidence and competence as it removes an operational barrier to interaction.

> It's gotten easier since the first time we used it. At first I did struggle because it was a little bit more to remember but now I know it's OK (L4n)

Many of the first time users within the focus groups alluded to a lack of self-belief in using the tool, which Zepke and Leach (2010) consider a key attribute in motivation. Student feedback in the earlier study (Raghubansie et al. 2014) indicated that a similar lack of self-belief existed in competence to make personal opinions accessible to others via posts. In response the tutors introduced group posts to allow discussion around the wide-reaching nature of sustainability to build confidence prior to posting. This issues also emerges in the study as focus group participants identify a number of potential causes of these self-belief limitations, for example, not knowing each other well and preference for the University wide VLE 'Blackboard' discussed below:

> I feel like I couldn't comment on anyone's post in this room because we don't know each other that well (L4n)

This lack of self-belief could also be related to students' level of inexperience and lack of familiarity with the tool, as the L5 students who have used it at L4 did not make similar comments. However, L5 students' feedbacks suggested that the more familiar the site becomes, the fewer attitudinal concerns remain.

> Once you've learnt it its quite easy, for example re-sizing an image or entering a heading. They are the important things which you need to know as you start. Once you have learnt how to do so, it is easy (L5e)

Whilst every effort was made to equip students and staff with appropriate access and skills, a combination of factors hinders this process including varied levels of student skill, competence and commitment and staff availability and training.

3.3 Cultural Factors

The VLE aims to assist students to accept and participate in digital learning culture that bridges the gap between students' social use of digital media and digital literacy for sustainability learning. Participation in the forum provided within the VLE enables students to develop a professional sustainability voice and enhance

communication skills that can be carried forward to employment. It also enables them to demonstrate participation in ESD and competence in digital literacy through the use of an industry standard digital content management system, WordPress.

The authors have embraced a culture of shared social practices through teaching and learning, using the VLE for the construction of knowledge which Fabricatore and Lopez (Fabricatore and López 2012) consider the required basis for ESD. Laird and Kuh (2005) recognise this learning culture is influenced by students' experiences with, and expectations of, information technology.

The expectation of just-in-time learning emerges as a cultural factor for the students' engagement with the VLE. Students typically obtain instant messages from Blackboard informing them of updates to academic information and alerts to new user-generated content from Facebook, Snapchat, Linkedin, etc. The lack of instant messaging from the VLE was discussed and may be a factor influencing engagement. It also appears to be contributing to a student culture that expects media sharing and networking with conversational areas such as chat rooms within the VLE.

This research supports the findings of Kennedy et al. (2008) that although many students are "tech savvy", when they move away from familiar technologies and tools they show varying patterns of competence and self-belief.

Time pressures preventing online engagement were raised by some students. As well as this, the pedagogical issue of self-belief discussed above and/or the difficulties that some students find to motivate themselves to use the VLE could relate to concerns over self-perceived competence, which Fazey and Fazey (2001) and Lizzio and Wilson (2013) identify as a key motivator for engagement.

> Although I have said negative things about it and it hasn't suited me, I can appreciate it will help other people. I have posted on the site many times, it's just motivating myself to actually post (L5e)

> I would argue that the biggest barrier for me is the idea of it being a chore to post things or upload things. And for it to be quite difficult to write your own posts on it and it really puts me off as its easier using alternative social media as we're a lot more familiar with it (L4n)

An interesting difference in the perception of the VLE emerges from the research, between a staff objective of the site creating a professional community of practice and the students' perception of the private site of susthingsout.com as informal community of enquiry:

> It's a nice friendly environment where you can informally comment on people's profiles (L4n)

> It feels so similar to Facebook and informal that it seems very casual (L4n)

> I think it's good for our learning that it is casual. If it was more formal then we would really struggle to relate to what we are writing and you couldn't just express yourself (L4n)

Staff reflections highlighted the ability to adapt the feedback provided to individuals and groups to be appropriate for the academic level of the student. This

helps protect the learning environment of the VLE rather than it becoming a networking site for social enhancement or social compensation (Kuss and Griffiths 2011) to which its perception of informality could lead.

The VLE is used to assist students develop a professional, self-competent digital presence and confidence in the use of digital media. Focus group participants' feedback highlights an interesting difference in the self-competent digital presence of L4 and L5 students. L4 students recognise the VLE as an informal environment. However, by the second year of use this reflection is no-longer evident. Staff members reflect that students develop these skills and competencies over time and with the support provided by the teaching team.

3.4 External Factors

The VLE aims to utilise online skills that students have already developed independent of academia and equip learners with enhanced digital proficiency to demonstrate employment skills to prospective employers, such as WordPress operation and digital communications, which are much in demand in the workplace. Students in all focus groups identified the VLE as a positive aid in gaining employment. L4 students considered this would become more important within second and third year undergraduate courses whereas L5 students discussed at length the opportunities they are offered. This may reflect the challenge in the wider higher educational environment for students to attain a passport to employment (Zepke and Leach 2010) and suggests employment skills are a key factor to consider when establishing, introducing and operating digital learning platforms for sustainability.

> I really like the idea of sitting in an interview and hyper-linking all of our work (L5e)

> I think it will be for 2nd and 3rd years. If you went into a job interview you could show them susthingsout.com and it's all grouped together (L4n)

On the negative side, one external factor impacting the students' engagement with the VLE is the institutional structure Blackboard. This is the standard University of Worcester course management system with which students engage on a daily basis. A Blackboard signpost to the VLE was established to address previous research findings as this appears to be an issue for a few novice users. Students' self-belief in competence with Blackboard appears to be a motivational factor for their perception that the VLE is a supplementary tool:

> If you could comment on Blackboard I would be set as it fits in with all of the subjects. I use Blackboard nearly every single day, especially when I have lectures and things like that. Susthingsout can be very limited. I only use it occasionally and when I do, or I've been asked to do something, it feels like a chore using the website (L5n)

> Every other subject we have is Blackboard so you get used to it. At the moment where most use Blackboard and only this uses susthingsout, it makes me question what is the point and I steer towards Blackboard (L4n)

Students' preferences for Blackboard clearly emerge from the research and appear to stem from its perceived ease of use and/or consistency with other modules. However, a number of students suggested there could be an opportunity to utilise both platforms; Blackboard for lecture materials and the VLE for sustainability information and discussion.

> I think it should be the information for that module as an extra piece that you can go on and blog about the lecture. I think your assessment stuff should be on Blackboard so we can see where you are with all of our other stuff so you don't lose track. We can then log on and do our blog separately (L5n)

Staff reflections suggest that novelty of student life for L4 participants may influence their engagement with the VLE. Participation in the module entails some engagement beyond the classroom and demands time management skills which many have yet to learn. This may lead to conflicts with part-time jobs or social events in which independent learning tasks lose out. The lack of instant messaging discussed above may contribute to this. Absenteeism of students is also considered to impact on their self-belief in digital competences.

4 Discussion of Findings

The findings analysed above suggest that the VLE is adding value to ESD in its development of a learning community, which Zhao and Kuh (2004) positively associate with the development of practical competencies, greater efforts by students and ultimately deeper engagement. The development of deeper engagement in learning strategies for ESD and enhancing digital proficiency were primary purposes in establishing the VLE. It has been the key tool addressing the complex, open-ended systems of ideas and inter-relationships within sustainability that are frequently emerging concepts and contentious fields of enquiry (Sterling 2012).

Despite some concerns with the impacts from the pedagogical, operational, cultural and external factors influencing students' engagement with the VLE, the authors recognise that it has successfully introduced points of good practice into the teaching and learning environment for ESD that may be of use for developers of online sustainability materials and other practitioners in guiding similar educational exercises.

5 Good Practice for Digital Learning for ESD

To offer insights to developers of online sustainability materials, and other practitioners in guiding similar educational exercises, the feedback from the focus groups and staff reflections presented above are synthesised using the 'barriers and

pathways' approach (Sterling 2012). This provides a structure to capture and share emerging knowledge of good practice.

This synthesis has generated five barriers and nine pathways to driving good practice into the development of digital learning platforms for ESD. Each of these barriers and pathways is linked to one or more of the four categories of pedagogical, operational, cultural and external factors that exemplify the skills and competencies being built into education practice and policy within ESD. These are shown in Table 1.

Table 1 Good practice in developing digital learning for ESD

Barrier	Key influences	Factor	Pathway
Limited recognition of purpose and intention of VLE	Knowledge community versus community for enquiry	Pedagogical	• Establish expectations differentiating learning and information • Communication of peer-to-peer knowledge transfer and learning outcomes • Establish expectations of quality and content of interactions • Establish academic challenges to encourage engagement
	Familiarity with other VLEs and course management systems	External	• Maximise similarity with established social media-tools • Develop learning outcomes for tool and set expectations • Continual communication of processes
Limited self confidence and self belief in use of VLE	Self-belief	Pedagogical	• Associate digital learning with academic challenge to develop recognition of personal resources • Set expectations to manage boundary between specialist opinion and student creativity • Facilitate student interaction to generate learning experiences • Provide room for experiment

(continued)

Table 1 (continued)

Barrier	Key influences	Factor	Pathway
	Digital competence	Operational	• Training in use of tool • Develop student skills to become co-creators • Understand students' ability and willingness to engage with digital learning
Students as "digital natives" - expectations from their social media environment	Just-in-time learning	Cultural	• Implement instant messaging function • Understand the student experience
	Formality versus Informality	Cultural	• Establish learning outcomes to create boundary between formal and informal learning
Perception of the VLE as a community of enquiry	Single point of information access	Operational	• Facilitate knowledge building and participatory engagement through mutual support, communication and collaborative learning • Develop exploration of user generated content to develop reflective approaches
Limited recognition of VLE as an opportunity to demonstrate sustainable learning	Motivation to engage	Cultural	• Link to assessment • Understand the student experience • Engage participants with a collective and individual sense of responsibility
	Value as an employment skill	External	• Set tasks to maximise skills • Develop aspects of tool to provide business needs

Adapted from Sterling (2012)

6 Conclusion

Progress has been made since the original study (Raghubansie et al, 2014). Findings from this research support the view of Johnson et al. (2014) that digital literacy is less concerned with tools than thinking. Self-belief, familiarity with existing course management systems, social media platforms and user-generated communication informality leads students to develop expectations of the operation of digital

learning platforms. This should be understood to ensure any new VLE meets expectations to achieve participatory interaction and engagement.

The positive opportunities the digital learning platform offer are clearly recognised and appreciated by students. The additional opportunity to discuss topics outside of the classroom is considered particularly valuable for students lacking confidence and where topics are potentially controversial. There is also consensus on the benefits obtained from using the VLE to ask for help from peers and also on the quality of the feedback received from tutors and the value this feedback offers in terms of student learning. This research provides evidence that a few novice students, at level 4, do not appear to have appreciated the VLE as an opportunity to demonstrate learning or access the expertise of others although this may actually be occurring.

Overall a strong sense emerges from the focus groups that the VLE appears to be achieving its aim by adding to student learning via receiving tutor feedback and signposting. The student tone was very upbeat and in favour of the use of this platform; they also seemed to completely appreciate the context of it as part of their learning experience.

Despite efforts to clarify expectations following the pilot study, a few L4n students remain to be convinced as to the purpose and intention of the VLE. Those users who have engaged more deeply with the VLE recognise these intentions. Further research will help establish whether the interventions put into place during this academic year, such as additional training and on line tasks set by tutors to increase familiarity with the tool, will improve overall student learning experience. In addition, practical steps have been taken for example automatically notifying students by email when the site is updated.

Having identified the factors affecting student engagement with the VLE, and having synthesised them (Table 1) further research is planned. In the medium term this will involve assessing which of the factors and pathways can be manipulated, and how, in order to maximise the effectiveness of the VLE thereby addressing the barriers identified by this study to improve the student learning experience.

In the opinion of the authors, the opportunities presented to the students to gain understanding, engage in deep learning, and develop valuable skills, greatly outweigh any barriers faced in the further development the VLE.

References

Alessandrini, M. (2012). *Non-positivist Approaches to Research in the Third Sector: Empowered Policy-making*. Conference paper presented at the 10th International Conference Universita Degli Studi di Siena, Italy July 10–13, 2012. Available from https://www.istr.org/resource/resmgr/wp2012/m_alessandrini.pdf. Accessed March 08, 2016.

Bertrand, J. T., Brown, J. E., & Ward, V. M. (1992). Techniques for analysing focus group data. *Evaluation Review*, *16*, 198–209. Available from http://www.sagepub.com. Accessed October 27, 2015.

Boud, D., & Molloy, E. (2013). *Feedback in higher and professional education: Understanding it and doing it well*. London: Routledge.

Dengler, M. (2008). Classroom active learning complemented by an online discussion forum to teach sustainability. *Journal of Geography in Higher Education, 32*(3), 481–494. Available from http://www.tandfonline.com/doi/abs/10.1080/03098260701514108. Accessed December 16, 2015.

Demian, P., & Morrice, J. (2012). The use of virtual learning environments and their impact on academic performance. *Engineering Education, 7*(1), 11–19. Available from http://dspace.lboro.ac.uk. Accessed January 19, 2016.

Fabricatore, C. & López, X. (2012). Sustainability learning through gaming: An exploratory study. *Electronic Journal of E-Learning, 10*(2), 209. Available http://www.proquest.com. Accessed March 08, 2016.

Fazey, D., & Fazey, J. (2001). The potential for autonomy in learning: Perceptions of competence, motivation and locus of control in first-year undergraduate students. *Studies in Higher Education, 26*(3), 245–261. Available from http://www.tandfonline.com. Accessed November 15, 2015.

Higher Education Academy. (2014). *Education for sustainable development: Guidance for UK higher education providers*. Available from http://www.qaa.ac.uk/en/Publications/Documents/Education-sustainable-development-Guidance-June-14.pdf. Accessed December 05, 2015.

HEFCE. (2013). *Sustainable development in higher education: Consultation on a framework for HEFCE*. Higher Education Funding Council for England. Available from http://www.hefce.ac.uk. Accessed December 12, 2015.

Houghton, W. (2004). *Engineering subject centre guide: Learning and teaching theory for engineering academics*. Loughborough: Loughborough HEA Engineering Subject Centre.

Hockings, C., Cooke, S., Yamashita, H., McGinty, S., & Bowl, M. (2008). Switched off? A study of disengagement among computing students at two universities. *Research Papers in Education, 23*(2), 191–201. Available from http://www.tandfonline.com. Accessed November 12, 2015.

Hutchings, M., Hadfield, M., Howarth, G., & Lewarne, S. (2007). Meeting the challenges of active learning in web-based case studies for sustainable development. *Innovations in Education and Teaching International, 44*(3), 331–343. Available from http://www.tandfonline.com. Accessed December 07, 2015.

Isacsson, A., & Gretzel, U. (2011). Facebook as an edutainment medium to engage students in sustainability and tourism. *Journal of Hospitality and Tourism Technology, 2*(1), 81 – 90. Available from http://www.emeraldinsight.com/doi/abs/10.1108/17579881111112430. Accessed December 07, 2015.

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2014). *NMC horizon report 2014 Higher education edition*. Austin Texas: The New Media Consortium. Available from http://www.nmc.org. Accessed December 01, 2015.

Kennedy, G., Judd, T., Churchward, A., Gray, K., & Krause, K. (2008). First year students' experiences with technology: Are they really digital natives? *Australian Journal of Educational Technology, 24*(1), 108–122. Available from http://www.ajet.org.au. Accessed December 04, 2015.

Kuss, D. J., & Griffiths, M. D. (2011). Online social networking and addiction—A review of the psychological literature. *International Journal of Environmental Research and Public Health, 8*(9), 3528–3552. Available from http://doi.org. Accessed December 04, 2015.

Laird, T. F., & Kuh, G. D. (2005). Student experiences with information technology and their relationship to other aspects of student engagement. *Research in Higher Education, 46*(2), 211–233. Available from http://www.proquest.com. Accessed March 08, 2016.

Li, R. Y. M., & Pak, D. H. A. (2010), Resistance and motivation to share sustainable development knowledge by Web 2.0. *Journal of Information & Knowledge Management, 9*(3), 251–262. Available from http://www.worldscientific.com/doi/abs/10.1142/S0219649210002656?journalCode=jikm. Accessed December 02, 2015.

Lizzio, A. & Wilson, K. (2013). First-year students' appraisal of assessment tasks: Implications for efficacy, engagement and performance. *Assessment & Evaluation in Higher Education, 38*(4), 389–406. Available from http://www.tandfonline.com. Accessed December 16, 2015.

Lyndon, S., & Hale, B. (2014). Evaluation of how the blended use of a virtual learning environment (VLE) can impact on learning and teaching in a specific module. *ELiSS, 6*(1). Available from https://www.heacademy.ac.uk/sites/default/files/elss.6.1b.pdf. Accessed January 18, 2016.

Morgan, D. L. & Spanish, M. T. (1984). Focus groups: A new tool for qualitative research, *Qualitative Sociology, 7*(3), 253–270. Available from https://www.researchgate.net. Accessed March 07, 2016.

Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon Report, 9*(5). Available from http://pre2005.flexiblelearning.net.au. Accessed December 04, 2015.

Raghubansie, A., Corbett, W., Boom, K., & Weaver, L. (2014). *Digital learning for sustainability: An interactive magazine for students, academics and expert practitioners* (pp. 3–17). World Sustainability Series. Available from http://link.springer.com/chapter/10.1007%2F978-3-319-10690-8_1#page-1. Accessed December 18, 2015.

Schön, D. A. (1987). *Educating the reflective pratictioner: Towards a new design for teaching and learning in the professions*. San Francisco, CA: Jossey Bass.

Sibbel, A. (2009). Pathways towards sustainability through higher education. *International Journal of Sustainability in Higher Education*, *10*(1), 68–82. Available from http://www.emeraldinsight.com/doi/full/10.1108/14676370910925262. Accessed December 02, 2015.

Sterling, S. (2012). *The future fit framework: An introductory guide to teaching and learning for sustainability in HE*. York: The Higher Education Academy Available from https://www.heacademy.ac.uk/sites/default/files/future_fit_270412_1435.pdf. Accessed March 04, 2016.

United Nations. (2015). Sustainable development goals, 17 goals to change our world. Available from http://www.un.org/sustainabledevelopment/sustainable-development-goals/. Accessed December 07, 2015.

University of Worcester. (2013). Strategic Plan 2013–18. Available from http://www.worcester.ac.uk/documents/university-worcester-strat-plan-2013-18.pdf. Accessed December 01, 2015.

Van Wynsberghe, R., & Andruske, C. L. (2007), Research in the service of co-learning: Sustainability and community engagement. *Canadian Journal of Education, 1*(1), 349–376. Available from http://www.csse-scee.ca/CJE/Articles/FullText/CJE30-1/CJE30-1-VanWynsbergeAndruske.pdf. Accessed December 02, 2015.

Zepke, N., & Leach, L. (2010). Improving student engagement: Ten proposals for action. *Active Learning in Higher Education, 11*(3), 167–177. Available from http://www.sagepub.com. Accessed December 03, 2015.

Zhao, C. & Kuh, G. D. (2004). Adding value: Learning communities and student engagement. *Research in Higher Education, 45*(2), 115–138. Available from http://link.springer.com/. Accessed on March 05, 2016.

Authors Biography

Dr. Kay Emblen-Perry has several years' of senior environmental and ecology consultancy experience delivering consultancy projects in renewable energy technologies, contaminated land remediation, biodiversity offsetting and ecological assessment for UK organisations. She is qualified as an environmental and quality lead auditor, has implemented environmental management systems for both UK and multinational organisations and has trained environmental and quality assessors. In previous roles Kay gained senior project management and purchasing management experience in international automotive companies. She project managed the implementation of sustainable supply chain strategies, new vehicle projects and EU REACH Regulations. Kay's specialisation is in Sustainable Management including Environmental

Management and Justice, Social Responsibility and Economic Sustainability. Her latest research project involves improving energy efficiency and conservation activities within small and medium businesses. She is also involved in research into the gamification of ESD.

Dr Sian Evans is a visiting lecturer in human geography with interests in sustainability and human ecology. She has provided research support to several European funded projects on sustainability and assisted with the implementation of environmental management systems in the cables industry.

Katy Boom is Director of Sustainability. She has led the development of wide ranging sustainability initiatives on campus, community and in the curriculum. The University consistently tops the national sustainability leagues and became the first English University to be awarded platinum EcoCampus status. For overseeing students as partners on major sustainability change programmes and building sustainability skills with students and student volunteers, Katy's work has won a number of national awards.

Wendy Corbett is an associate lecturer in Creative Digital Media with over 10 years expertise delivering digital publishing projects. For 6 years she was Director of the International Herald Tribune and 5 years as Senior Multimedia Designer developing digital strategies for government sustainability projects.

Lorraine Weaver is Head of the Biological Sciences and is lead academic for the sustainability elective modules. She is a principal lecturer and UW Teaching Fellow, a Fellow of the Society of Biology and a Chartered Biologist, Lorraine and is also chair of the university Strategic Biodiversity Management Group. She is involved in research into waste management in agricultural systems.

Measuring Progress Over Time: The Sustainability Cultural Indicators Program at the University of Michigan

John Callewaert and Robert W. Marans

Abstract

The Sustainability Cultural Indicators Program (SCIP) is a multi-year project designed to measure and track the *culture of sustainability* at the University of Michigan. It is intended to inform U-M administrators and others responsible for day-to-day operations of the University including its academic programs. Furthermore, it is intended to serve as a model demonstrating how behavioral research can be used to address critical environmental issues within universities generally and in other organizational settings. Culture of sustainability is meant to reflect a set of attitudes, behaviors, levels of understanding and commitment, degrees of engagement, and dispositions among a population such as members of a university community. This paper presents findings from three years of data collection (2012–2014)—focusing on trends in responses from over 17,000 students, faculty, and staff. One of the most positive findings is that respondents report increasing levels of sustainability knowledge over time. However, SCIP results indicate that there is considerable room for improvement with regard to pro-environment behavior, engagement, and expressed commitment to sustainability. Finally, a brief overview is provided of how SCIP results are being used by multiple units on campus to guide programming and how SCIP is informing efforts at other institutions.

J. Callewaert (✉)
Graham Sustainability Institute, University of Michigan, 625 E. Liberty, Suite 300, Ann Arbor, MI 48104, USA
e-mail: jcallew@umich.edu

R.W. Marans
Institute for Social Research, University of Michigan, 426 Thompson Street, Ann Arbor, MI 48106, USA
e-mail: marans@umich.edu

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_13

Keywords
Campus sustainability · Survey research · Cultural indicators

1 Introduction

1.1 Campus Sustainability Integrated Assessment

In October 2009, former University of Michigan (U-M) President Mary Sue Coleman elevated the University's commitment to sustainability in teaching, research, operations, and engagement by creating the U-M Environmental Sustainability Executive Council.[1] One of the first actions of the Council was endorsing a Campus Sustainability Integrated Assessment (CSIA) to analyze the U-M's sustainability efforts to date, benchmark against other institutions, and chart a course for the future through identifying long term goals for sustainable operations on the U-M Ann Arbor campus, including the Athletic Department and the Health System. The CSIA builds on a long history of sustainability commitments in U-M campus operations, such as implementing cogeneration technology at the Central Power Plant in the 1960s, adopting the EPA Green Lights and Energy Star programs in the 1990s, and more recently establishing LEED (Leadership in Energy and Environmental Design) Silver certification as the standard for new non-clinical construction projects where the construction value exceeds US$10M.

The geographic scope of the CSIA spanned the five Ann Arbor campuses (South, Central, Medical, North and East Medical), which currently includes over 3 million square meters of teaching, research, health care, athletics and administrative building space. In 2014, these buildings served more than 80,000 occupants—students, faculty and staff (University of Michigan 2015). Total campus operations generated over 700,000 metric tons of carbon dioxide emissions (Office of Campus Sustainability 2014). Additional information on sustainability at the University of Michigan can be found on the Planet Blue website—the main sustainability portal for academic, research, and operations initiatives.[2] The magnitude of U-M campus operations suggests that aggressive sustainability goals for University campus operations could have significantly positive environmental, fiscal, and health impacts.

The final CSIA report outlines four high level themes—*Climate Action*, *Waste Prevention*, *Healthy Environments*, and *Community Awareness*. Accompanying the

[1]The Council is comprised the University President, the Provost and Executive Vice President for Student Affairs, the Vice Presidents for Research, Student Affairs, Development, and Global Communications & Strategic Initiatives, the Executive Vice President for Medical Affairs, and the Executive Vice President and Chief Financial Officer.

[2]The Planet Blue website can be found at: http://sustainability.umich.edu/.

themes are Guiding Principles to direct the U-M's long-range strategy and 2025 Goals that are time-bound and quantifiable.[3] Table 1 provides an overview of the U-M's 2025 Sustainability Goals.

1.2 The Sustainability Cultural Indicators Program

Institutions of higher education play a pivotal role in addressing the more difficult yet powerful part of the sustainability transition. That role is in creating and maintaining a "culture of sustainability" among members of the university community. A culture of sustainability has been defined as "a culture in which individuals are aware of major environmental (and social/economic) challenges, are behaving in sustainable ways, and are committed to a sustainable lifestyle for both the present and future" (Marans et al. 2010, 2014). To achieve this ideal state within institutions of higher education, Sharp (2002) calls for a rethinking of organizational action and actors that questions the prevailing assumptions of organizational rationality that stays within the confines of the current systems. Similarly, Senge (2000) stresses the importance of cultivating a "learning organization," rather than a "knowing organization" since change at higher education institutions is a "complex learning and unlearning process for all concerned" (Scott 2004). Therefore, nothing less than a paradigmatic shift in organizational thinking is needed for colleges and universities to promote cultural transformation.

This organizational transformation is needed in all sectors of society. Yet institutions of higher education can and should be at the forefront with the collective mission of fostering sustainability through our actions and through cultivating future sustainability leaders. To date, however, most campus sustainability efforts stop either at "greening" or at the level of institutional commitments to eco-efficiency, climate and waste mitigation, and increasing environmental education. Though calls for institutional and cultural transformation are multiplying at a rapid rate, rarely do institutions address the deeper cultural change necessary to transform into sustainable organizations which empower citizens with a sustainability perspective; instead, focus is often on implementing many individual projects, isolated initiatives, or broad commitments (Sharp 2002, 2009). This is partly attributable to the lack of guidance for institutions attempting to follow this more uncertain and uncomfortable path. However, it should be noted that the Association for the Advancement of Sustainability in Higher Education is doing much to support these efforts through their Sustainability Tracking, Rating & Assessment System (STARS) which is used by hundreds of institutions. The 2.1 version of STARS asks institutions to report on both their sustainability literacy assessment efforts and assessing a culture of sustainability (AASHE 2016). In addition the

[3]More information on the CSIA process, outcomes, and evaluation can be found at: http://graham.umich.edu/knowledge/ia/campus. Information on progress towards the 2025 Climate Action, Waste Prevention, and Healthy Environments goals can be found at: http://www.ocs.umich.edu/goals.html.

Table 1 CSIA themes, guiding principles, and 2025 goals

Theme	Guiding principle	2025 Goals
Climate action	We will pursue energy efficiency and fiscally-responsible energy sourcing strategies to reduce greenhouse gas emissions toward long-term carbon neutrality	Reduce greenhouse gas emissions (*scopes 1 and 2*) by 25 % below 2006 levels Decrease carbon intensity of passenger trips on U-M transportation options by 30 % below 2006 levels
Waste prevention	We will pursue purchasing, reuse, recycling, and composting strategies toward long-term waste eradication	Reduce waste tonnage diverted to disposal facilities by 40 % below 2006 levels
Healthy environments	We will pursue land and water management, built environment, and product sourcing strategies toward improving the health of ecosystems and communities	Purchase 20 % of U-M food from sustainable sources Protect Huron River water quality by: • minimizing runoff from impervious surfaces (*outperform uncontrolled surfaces by 30 %*), and • reducing the volume of land management chemicals used on campus by 40 %
Community awareness	We will pursue stakeholder engagement, education, and evaluation strategies toward a campus-wide ethic of sustainability	*There is no goal recommendation for this theme. However, the report recommends investments in multiple actions to educate our community, track behavior, and report progress over time*

works of Bartlett and Chase (2004, 2013) have done much to chronicle institutional sustainability transformation efforts.

U-M cultural change initiatives stem from the principles outlined under CSIA theme of Community Awareness. They indicate that the U-M will "pursue evaluation strategies toward a campus-wide ethic of sustainability" as articulated in President Coleman's September 2011 speech announcing the sustainability goals. Specifically, she stated that "we will scientifically measure and report our progress and behavior as a community…ISR (Institute for Social Research) researchers will measure the sustainability attitudes and activities of students, faculty and staff, as well as identify where we can improve." The evaluation strategies involve a groundbreaking program for monitoring the U-M's progress in moving toward a culture of sustainability. Progress would be determined by an annual survey of students, faculty and staff regarding sustainability awareness and behavior and tracking changes over time.

To create the surveys, a small group closely involved with the CSIA met for over a year working on what came to be known as the Sustainability Cultural Indicators Program (SCIP). The group started by examining the recommendations from the Campus Integrated Assessment Culture Team report, reviewed related literature, spoke to key national leaders working on similar efforts, ran focus groups with students and staff to determine current understandings of sustainability, and analyzed more than thirty existing campus surveys from numerous institutions (including the U-M) about topics such as recycling, transportation, etc.

One of the most useful resources for this work was the North American Association for Environmental Education's report "Developing a Framework for Assessing Environmental Literacy" (Hollweg et al. 2011). It provided a very useful frame for developing questions under three categories; knowledge, dispositions or attitudes, and behavior. This went beyond many of the existing campus surveys which focused primarily on sustainability literacy or environmental literacy, or which focused exclusively on operational outcomes.

SCIP uses two questionnaires—one for staff and faculty, and one for students. While many of the questions are similar, different time frames and sequences are used in the two versions. For example, while staff and faculty survey questions are primarily set within a time frame of the past year, students are often asked to answer questions based on their experiences since the start of the fall semester. Also, students are asked several demographic questions at the start of the survey such as whether they live in campus housing or not in order to skip certain questions which do not apply to students living in campus housing. Staff and faculty demographic questions are asked at the end of the survey. As a primary objective of SCIP is to work closely with the goals of the CSIA, questionnaire modules were developed with questions focusing on transportation, waste prevention, the natural environment, food, climate change, as well as U-M sustainability efforts, and respondent demographics. In addition to the student questionnaire there is a slightly shorter version which is sent to members of an undergraduate student panel who are asked to complete the survey each year during their undergraduate studies. The panel was included in the research plan so as to determine if and how the behaviors and views of individual students change during their period of undergraduate study at the University. The average time to complete the online survey is about 15 min. Figure 1 offers an example of a SCIP question.

Table 2 offers an overview of the question type and modules. In total, the questionnaires each contained approximately 242 questions although respondents could skip any question they did not want to answer and responses to some questions generated a skip sequence for subsequent questions. A limited number of modifications have been made to the questionnaires each year—adding questions, deleting questions, or clarifying questions—with the goal of as little modification as possible to avoid increasing the amount of time required by respondents to complete the survey and to allow for as much longitudinal analysis as possible.

Q8. How much do you know about the following at U-M?	A lot	A fair amount	A little	Not much/ nothing
a. Recycling glass	○	○	○	○
b. Recycling plastic	○	○	○	○
c. Recycling paper	○	○	○	○
d. Recycling electronic waste (i.e. computers, cell phones)	○	○	○	○
e. Property Disposition Services	○	○	○	○
f. Composting	○	○	○	○

Fig. 1 SCIP question example

Table 2 SCIP survey questions by module and question type

Survey module	Question type					
	Knowledge	Disposition	Behavior	Other	Demographics	Total
Transportation	9	10	21	1	0	41
Conservation	5	5	33	1	0	44
Environment	4	2	9	1	0	16
Food	7	6	19	2	0	34
Climate	1	2	0	2	0	5
Sustainability (gen)	0	20	13	3	0	36
U-M efforts	8	0	8	8	0	24
Demographics	0	0	0	0	42	42
Total	34	45	103	18	42	242

2 Population and Sample

In order to ensure proportional representation from all segments of the University community and from all geographic parts of the Ann Arbor campus, the sample design aims to obtain relatively large numbers from the entire student body and from the population of staff and faculty. Specifically, a stratified sample is selected by the Registrar's Office so as to yield approximately 1000 respondents from the freshmen class, 350 respondents from each of the sophomore, junior and senior classes, and 400 graduate student respondents. For the undergraduate panel, graduating seniors are replaced with the freshmen from the prior year with approximately 300 sophomores, juniors and seniors completing the survey in the years following their first year to yield 900 panel respondents. Finally, a stratified

Table 3 Completed surveys by population and campus response rates; 2012–2014

Population	Year		
	2012	2013	2014
Students (undergrad and grad)	4018	2396	3172
Panel (undergrad)		841	1048
Faculty and staff	2166	1547	2149
All campus response rate (%)	44	22	29

sample is selected by the University's Office of Human Resources with a target of 750 staff and 750 faculty members (Hupp 2016).

The actual number of respondents and the response rates for 2012–2014 are shown in Table 3. The lower response rates in 2013 were attributed to U-M's transition to Gmail during the period of the SCIP data collection and the fact that many emails with links to questionnaires ended up in SPAM folders. New email distribution plans were implemented in 2014 and response rates improved. Completion of questionnaires is attributable to several factors including the personalized pre-notification email encouraging participation from the U-M President, a series of reminder e-mails from a different U-M head coach each year, and an opportunity for respondents to participate in a gift card drawing.

3 Findings

Results from the questionnaires are shared in several ways with the U-M campus community and others. Each year an annual report is prepared which provides detailed information on the respondent population and response distribution tables for nearly every question. In addition, a publicly available composite table is maintained online for sharing the results to questions and how responses are changing over time or staying the same. Where indicated, statistical significance is reported between the current year and the previous year, and the current year and the first year of data collection (2012). The SCIP teams holds multiple meetings throughout the year with staff from various campus operations units (transportation, dining services, health system, etc.), students and faculty to discuss the results and determine ways in which the results can be used to guide future programming, education, and research efforts. An example of how results are shared in the composite table can be found in Table 4.

In order to summarize findings covering key concepts reflecting a culture of sustainability, indices were created that combined responses to closely related questions about a common idea, concept, or action. The procedure consisted of two steps. First, conceptually related items were identified and, for each respondent, the coded or numeric values of the responses to each were combined or added together.

Table 4 Select results for all students regarding transportation to campus, 2012–2014

Travel and transportation items (percentage distributions)	All students		
	2012	2013	2014
During the past year, how often did you do the following to travel from where you lived and campus:			
Drive a car and park on campus			
Never	54	51	51
Rarely	20	19	20
Sometimes	16	21	18
Always/most of the time	10	9	11
Number of respondents	3961	2293	3170
Significance between current year and previous year		n.s.	n.s.
Significance between current year and 2012		n.s.	$p < 0.05$
Walk			
Never	15	17	14
Rarely	7	5	7
Sometimes	16	14	17
Always/most of the time	62	64	62
Number of respondents	3981	2287	3164
Significance between current year and previous year		n.s.	$p < 0.05$
Significance between current year and 2012		n.s.	n.s.
Bike			
Never	68	66	67
Rarely	9	11	10
Sometimes	12	14	12
Always/Most of the time	11	11	11
Number of respondents	3902	2253	3124
Significance between current year and previous year		n.s.	n.s.
Significance between current year and 2012		n.s.	n.s.

For most of the indices, the number of response categories to their respective questions was identical.[4] Numerical values were assigned to responses such that higher values represented the most sustainable forms of behavior or the highest levels of awareness, while the lower values represented the least sustainable behaviors or lowest levels of awareness. For example, for responses to the question, "During the past year, how often did you turn off lights when leaving the room", "always/most of the time" was coded 4, "sometimes" was coded 3, "rarely" was coded 2, and "never" was coded 1. Together with 3 other questions, the maximum summary score for any respondent would be 16 and the minimum score would be 4.

[4]The exception was Sustainability Food Purchase Index, where one question had five response options while the other two questions had four. These three variables could not be added up immediately. These three variables were first normalized and after normalizing, were added together.

The distribution of summary scores for all student and staff/faculty respondents was then tabulated.

Respondents who said "don't know" or "not applicable" to questions used in developing selected indicators were not included when building those indicators. That is, index scores were not calculated for these respondents. On occasion, some of the remaining respondents skipped one of the questions comprising the index. Rather than eliminating these respondents from the analysis and thus reducing the sample size, the modal value of all other respondents to the question was assigned to the non-response item. These respondents were then retained in the sample. The operational rule for dealing with missing values was as follows. For indicators consisting of one or two items, participants with one or two non-responses were excluded from the analysis. For indicators consisting of three items, respondents with one non-response were assigned the modal value to that item. For indicators using four or more than four items, participants who had more than 2 non-responses were eliminated from the analysis. Those with one or two non-response items were assigned the modal value of all responses to those items.

The second step involved the creation of a common metric or scale for all indicators. This was necessary since the range of scores for each indicator varied. Some varied from one to four while others varied from eight to thirty-two. In order to make the indicators comparable and easier to understand, all the indicators were converted to common metric or a zero-to-ten scale. For instance, the summed Waste Prevention Behavior Index for participants ranged from 4 to 16. In this case, the minimum value (4) was subtracted from the maximum value (16) resulting in a scale ranging from 0 to 12. Each value was then divided by the new maximum value (12), so that the new index score would be between 0 and 1. That score was then multiplied by 10, resulting in a value ranging from 0 to 10. SPSS Complex Samples was then used to determine the distributions and the mean scores of indicators.[5] In total 15 indicators were created. Ten primary indicators reflect U-M's campus sustainability goal areas and 5 secondary indicators reflect other key sustainability issues. Items used to create the indicators are shown in Table 5.

As shown in Table 6, several key items can be identified when reviewing the results from 2012 to 2014. First, there is considerable room for improvement with regard to pro-environment behavior, levels of awareness, degrees of engagement and expressed commitment to sustainability among members of the University community. Second, the travel behavior of students is more in line with the goal of greenhouse gas reduction than travel to and from campus by the staff and faculty. Not surprisingly, students are most likely to walk, bike, or bus to campus. Similarly, students are likely to know more about transportation options available to them and are more engaged than either staff or faculty in sustainability activities on campus.

Third, compared to students and staff, faculty tend to report acting in a more sustainable manner with respect to conserving energy, preventing waste, purchasing food, and more generally, engaging in pro-environmental activities outside the University. Faculty members also express a higher level of commitment to

[5]SPSS Complex Samples gives more accurate statistical estimates than Base SPSS.

Table 5 Items used for creating sustainability indicators

Name of index	Name of items	No. of items
Primary		
Climate action		
Conservation behavior	Turn off lights, use computer power-saver, turn off computer, use motion sensor	4
Travel behavior	Most often mode of travel to campus since fall semester	1
Waste prevention		
Waste prevention behavior	Print double-sided, recycle paper, etc., use reusable cups, etc., use property disposition	4
Healthy environments		
Sustainable food purchases	Buy sustainable food, organic, locally-grown	3
Protecting the natural environment	Use fertilizer, herbicides, water lawn	3
Community awareness		
Sustainable travel and transportation	Ann Arbor Area Transportation Authority, UM buses, biking, Zipcar rental	4
Waste prevention	Recycle glass, plastic, paper, electrical waste, property disposition	5
Natural environment protection	Dispose hazardous waste, recognize invasive species, residential property, protect Huron River	4
Sustainable foods	Locally grown, organic, fair trade, humanely-treated, hormones-free, grassfed, sustainable fish	7
U-M sustainability initiatives	Save energy, encourage bus or bike, promote ride sharing, recycling, sustainable food, reduce greenhouse gas, maintain grounds, protect Huron River	8
Secondary		
Sustainability engagement at U-M	Participate in sustainability organization, Earthfest, took a sustainability course (not for staff/faculty)	3
Sustainability engagement generally	Give money, voting, volunteering, serving as officer	4
Sustainability commitment	How committed to sustainability?	1
Sustainability disposition	Willingness to pay for expanded waste prevention, alternative transportation, and greenhouse gas reduction efforts at UM	3
Rating U-M sustainability initiatives	Save energy, encourage bus or bike, promote ride sharing, recycling, sustainable food, reduce greenhouse gas, maintain grounds, protect Huron River	8

sustainability than staff or students. Fourth, students tend to be less knowledgeable than staff or faculty about protecting the natural environment, preventing waste, and sustainable foods. However, they know as much as faculty about sustainability at

Table 6 Change in sustainability (mean sources) for all students, Staff and faculty—2012, 2013, 2014

Indices	All students			Staff			Faculty		
	2012	2013	2014	2012	2013	2014	2012	2013	2014
PRIMARY									
Climate Action									
Conservation Behavior	6.1	6.2	6.1	6.6	6.7	6.5	6.9	6.9	7.0
Travel Behavior	7.6	7.5	7.4	1.6	1.3	1.6	2.2	2.0	1.8
Waste Prevention									
Waste prevention behavior	6.6	6.6	6.7	7.0	7.0	6.5	7.3	7.3	7.4
Healthy Environments									
Sustainable food purchases	5.5	5.3	5.6	5.7	5.8	5.8	6.3	6.2	6.3
Protecting the natural environment	8.6	8.9	8.8	6.5	6.4	6.6	6.1	6.1	6.4
Community Awareness									
Sustainable travel and transportation	4.4	4.3	4.2	3.0	3.0	3.1	3.4	3.3	3.3
Waste prevention	4.0	4.2	4.2	5.0	5.1	5.0	5.1	5.4	5.5
Natural environment protection	3.1	3.3	3.4	4.1	4.3	4.3	4.3	4.6	4.6
Sustainable foods	4.3	4.5	4.8	4.7	5.1	5.0	5.6	5.7	5.7
U-M sustainability initiatives	5.1	5.1	5.0	5.4	5.6	5.3	4.9	5.1	5.0
SECONDARY									
Sustainability engagement at U-M	1.3	1.4	1.6	0.9	0.7	0.7	0.7	0.7	0.7
Sustainability engagement generally	1.9	1.8	2.0	1.9	1.9	1.8	3.0	2.9	3.0
Sustainability commitment	6.3	6.3	6.3	6.3	6.4	6.4	7.0	7.2	7.1
Sustainability disposition	3.5	3.3	3.4	2.9	2.6	2.5	5.3	4.6	5.0
Rating U-M sustainability initiatives	6.6	6.4	6.5	6.7	6.8	6.6	6.4	6.5	6.4

⬆ Significant change from 2012 (p<.001); ▲ Significant change from previous year (p<.001)
⬆ Significant change from 2012 (p<.01); ▲ Significant change from previous year (p<.01)
⬆ Significant change from 2012 (p<.05); ▲ Significant change from previous year (p<.05)

the University. Nonetheless, staff are most aware of the full range of the University's sustainability initiatives.

Finally, a review of the indicator scores from 2012 to 2014 shows that members of the University community report being more knowledgeable about sustainability over time. In some instances, indicator scores for 2014 are significantly higher than 2012 scores and/or higher than the 2013 scores. In the case of sustainable foods, significant positive changes between the 2014 score for students and both the 2012 and 2013 scores reflect a growing understanding of sustainable foods over the 3 years. In addition, the indicator score for student engagement (participate in a sustainability organization or took a sustainability course) revealed a statistically significant increase from 2012 to 2014.

The relatively large numbers of student, faculty and staff respondents each year enable the production of index scores for each of Ann Arbor's campuses, regions, and sub-regions of the most populated regions. The regions are based on similar regions developed by U-M's energy management teams (see Fig. 2). These different geographic areas present opportunities to conduct experiments or trial programs in some places and not in others in order to determine the impact of new initiatives. An example of the mapping work which can be done based on these regions is provided in Fig. 3.[6]

[6]Additional regional analyses can be found in the SCIP Annual Reports available at: https://graham.umich.edu/campus/scip.

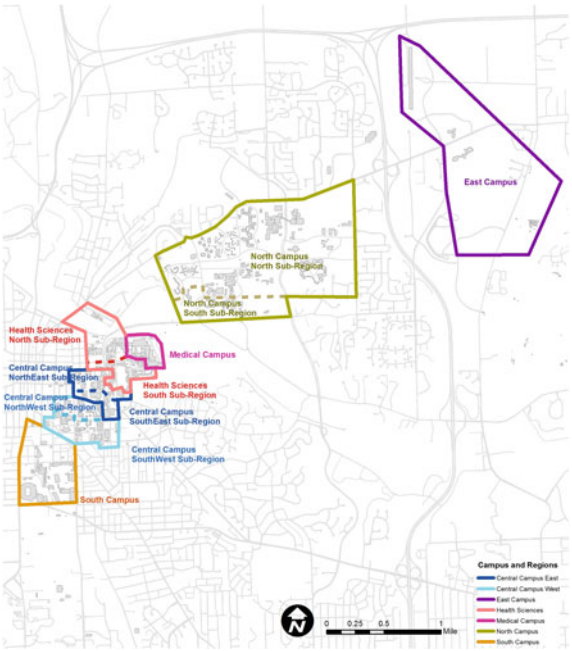


Fig. 2 Campus regions and subregions

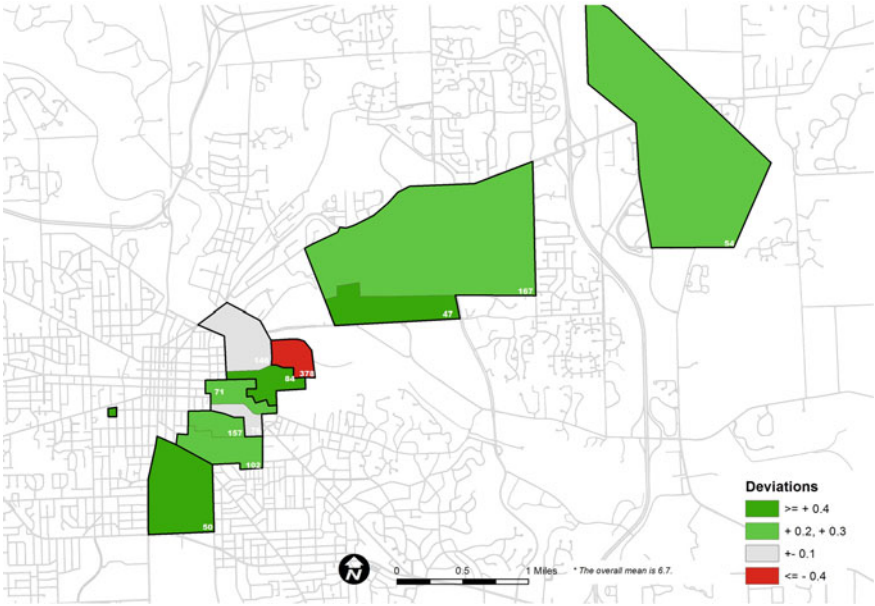


Fig. 3 Staff and faculty conservation behavior index mean deviation (2013) by Campus Region and Subregion (numbers in regions show number of respondents)

4 Going Forward

As noted above, the relatively large numbers of student, faculty and staff respondents each year and the creation of campus wide and regional indices present opportunities to conduct experiments or trial programs in some places and not in others in order to determine the impact of new initiatives. Current regional outreach efforts by the U-M Energy Management Group, a composting initiative by Student Life, and an assessment and recommendations regarding "barriers to recycling" are examples of how SCIP data is being used to gauge impact and guide programming. Such efforts are examined in more detail in a related SCIP paper (Marans and Callewaert 2016). In addition, we have begun to examine SCIP data in relation to contextual or environmental data derived from other sources such as metrics for campus energy use and recycling rates.[7] Furthermore, a graduate level course is also being developed for students to work with SCIP data each fall, develop programming interventions to support greater pro-environmental behavior, and for subsequent cohorts of students to test hypotheses based on SCIP data collected in the future.

In the fall of 2014 U-M President Mark Schlissel initiated a review of U-M's sustainability goals in three key areas—waste prevention, climate action, and culture. Teams of students, staff, and faculty were charged with reviewing current programs and their impacts on goal progress; identifying a range of options for making significant progress toward the goals, and developing high-level plans for achieving the goals. SCIP results were used to inform the work of the teams and the culture team's report included suggestions for additional ways SCIP results could be used to inform and evaluate campus sustainability efforts (Michels and Preston 2015).

Ongoing analysis of panel data is also providing important insights into promoting a culture of sustainability among the undergraduate population. Findings show that contrary to expectations, there was no difference in level of engagement between sophomores, juniors, and seniors who participated in the panel. Nonetheless, engagement of individual students increased over the one year period. At the same time, students who lived for at least one year in a residence hall as well as those who lived with more people were more likely to be engaged in sustainability activities than those who lived off-campus during the two years. Finally, the analyses show that higher levels of student engagement directly increase awareness of waste prevention behavior which in turn, alter waste prevention and conservation behaviors.

Finally, following the release of the Year 1 report a program website was developed to share key results and materials. During 2015 there were over 1000 views of the program website and the SCIP annual reports are one of the top ten file downloads from the Graham Sustainability Institute website.[8] More than 100 requests have been received for copies of the survey instruments from other institutions and there have been preliminary conversations about creating a common

[7]Initial results from this work can be found in the Year 3 report found at: http://graham.umich.edu/campus/scip/materials.

[8]The project website can be found at: http://graham.umich.edu/campus/scip.

instrument across institutions. In addition, two short animated videos have been prepared to succinctly describe SCIP. One is aimed at external audiences such as other universities, corporations, and cities while the second will be used within U-M.

Because of the groundbreaking nature of SCIP, its relationship to the many U-M initiatives designed to promote sustainability throughout the University and its importance in addressing cultural issues and behavioral change when dealing with complex and pressing environmental problems, we are eager to see the program replicated elsewhere. We believe that such efforts will be beneficial to other universities and colleges as well as to other types of institutions, corporations, and cities where movements toward a more sustainable future are taking place. It is our belief that in order for those movements to be successful, consideration needs to be given to shifting toward a culture of sustainability. The University of Michigan is doing so as part of its overall sustainability initiative and SCIP is the vehicle for measuring that change and assessing its impacts.

Acknowledgments The SCIP analytical work would not have been possible without the assistance of Will Chan, Minako Edgar, and Mary Hirt. We also acknowledge the statistical guidance provided by Brady West from ISR's Program in Survey Methodology, and, Dan Zahs, Heather Schroeder, as well as the expert survey administration efforts of Cheryl Wiese and Andrew Hupp from Survey Research Operations (SRO) of ISR's Survey Research Center. Finally, sincere appreciation must be extended to key leaders at the University of Michigan whose support makes SCIP possible—in particular, the Office of the President, the Office of the Provost, the Institute for Social Research, the Graham Sustainability Institute and the U-M Athletic Department.

References

Association for the Advancement of Sustainability in Higher Education (AASHE). (2016). Sustainability Tracking, Assessment & Rating System (STARS) 2.1 technical manual. https://stars.aashe.org/pages/about/technical-manual.html. Last Accessed March 19, 2016.

Bartlett, P. F., & Chase, G. W. (2004). *Sustainability on campus: Stories and strategies for change* (p. 337). Cambridge: MIT Press.

Bartlett, P. F., & Chase, G. W. (2013). *Sustainability in higher education: Stories and strategies for transformation* (p. 316). Cambridge: MIT Press.

Hollweg, K. S., Taylor, J. R., Bybee, R. W., Marcinkowski, T. J., McBeth, W. C., & Zoido, P. (2011). Developing a framework for assessing environmental literacy. http://www.naaee.net. Last Accessed January 14, 2016.

Hupp, A. (2016). Sustainability Cultural Indicators Program (SCIP) web survey of University of Michigan students, staff, and faculty: Methodology report. http://graham.umich.edu/campus/scip/materials. Last Accessed March 21, 2016.

Marans, R. W., Callewaert, J., & Shriberg, M. (2014). Enhancing and monitoring sustainability culture at the University of Michigan. In W. Leal Filho (Ed.), *Implementing campus greening initiatives: Approaches, methods and perspectives* (pp. 165–181). Frankfurt: Peter Lang.

Marans, R. W., Levy, B., Bridges, B., Keeler, K., Avrahami, T., Bennett, J., et al. (2010). Campus sustainability integrated assessment: Culture team phase I report. http://www.graham.umich.edu/pdf/culture-phase1.pdf. Last Accessed January 14, 2016.

Marans, R. W., Callewaert, J. (2016). Evaluating sustainability initiatives on university campuses: Examples from the University of Michigan's sustainability cultural indicators program. In: W. Leal Filho (Ed.), *Handbook of theory and practice of sustainable development in higher education* (Vol. 2). Berlin: Springer.

Michels, K. B. & Preston, S. D. (2015). Report for President Schlissel from the committee on the culture of sustainability at the University of Michigan. http://sustainability.umich.edu/media/files/Sustainability-Culture-Committee-Report-2015.pdf. Last Accessed March 25, 2016.

Office of Campus Sustainability. (2014). Sustainability goals, climate action: Greenhouse gas, University of Michigan. http://sustainability.umich.edu/ocs/goals/ghg. Last Accessed March 19, 2016.

Scott, G. (2004). Change matters: Making a difference in higher education. http://www.eua.be/eua/jsp/en/upload/Unive%20Tech%20final%20paper.1076689383316.pdf. Last Accessed March 21, 2016.

Senge, P. (2000). *The fifth discipline: The art and science of the learning organization* (p. 432). New York: Crown Business.

Sharp, L. (2002). Green campuses: The road from little victories to systemic transformation. *International Journal of Sustainability in Higher Education, 3*, 128–145.

Sharp, L. (2009). Higher education: The quest for a sustainable campus. *Sustainability: Science Practice and Policy, 5*, 1–8.

University of Michigan. (2015). STARS report. https://stars.aashe.org/institutions/university-of-michigan-mi/report/2015-06-30/. Last Accessed March 19, 2016.

Author Biographies

John Callewaert PhD is the Emerging Opportunties Program Director at the Graham Sustainability Institute and a Lecturer in the College of Literature, Science, and the Arts at the University of Michigan. As Emerging Opportunities Program Director at the Graham Institute, John is responsible for designing, implementing, and overseeing a wide range of activities which support translational knowledge efforts involving subject matter experts, decision-makers, and key stakeholders in outlining viable pathways toward sustainability solutions. Dr. Callewaert came to the Graham Institute in 2009 after serving for two years as the Director of the University of Michigan-Flint Office of Research. From 2000 to 2007, Callewaert was the founding director of the Institute for Community and Environment at Colby-Sawyer College and an Associate Professor of Social Sciences and Education. Between 1984 and 1987 he served as an agricultural volunteer with Peace Corps Nepal working on improving seed supplies in remote hill villages. Dr. Callewaert serves as an associate editor for the Journal of Environmental Studies and Sciences and as an advisory board member for The Integrated Assessment Society.

Robert W. Marans PhD FAICP is Research Professor at the University of Michigan's Institute for Social Research and Professor Emeritus of Architecture and Urban Planning in the university's Taubman College of Architecture and Urban Planning. For more than three decades, he has conducted evaluative studies and research dealing with various aspects of communities, neighborhoods, housing, and parks and recreational facilities. His research has focused on user requirements and the manner in which attributes of the physical and sociocultural environments influence individual and group behavior and the quality of community life. Dr. Marans' most recent book, *Investigating Quality of Urban Life: Theory, Methods, and Empirical Research* was published by Springer (2011). His current research considers the impact of the built and natural environments on quality of life, the role of neighborhood in the health of Detroit residents, and issues of sustainability and energy conservation in buildings and institutional settings.

Evaluating Sustainability Initiatives on University Campuses: A Case Study from the University of Michigan's Sustainability Cultural Indicators Program

Robert W. Marans and John Callewaert

Abstract

The Sustainability Cultural Indicators Program (SCIP) is a multi-year program intended to inform University officials and others responsible for day-to-day operations including assessments of new sustainability initiatives. Following a brief review of ways in which SCIP data have been used by operations personnel at the University, a detailed discussion of one sustainability initiative and the use of SCIP data to assess its effectiveness is presented. The sustainability initiative deals with an expansion of composting in University residence halls beyond their dining facilities. A trial outreach program is introduced in one of the University's 17 undergraduate residence halls is described together with a plan for evaluating its outcomes using SCIP data. The results of the evaluation will help determine if and in what ways a composting program should be extended other residence halls. Outcomes from such sustainability trials can be helpful to university officials in determining the extent to which new sustainability initiatives are successful, whether or how they should be modified, and whether they should be implemented throughout other parts of the university, or discontinued.

Keywords

Campus sustainability · Evaluation research · Composting · Sustainability indicators

R.W. Marans (✉)
Institute for Social Research, University of Michigan, 426 Thompson Street, Ann Arbor, MI 48106, USA
e-mail: marans@umich.edu

J. Callewaert
Graham Sustainability Institute, University of Michigan, 625 E. Liberty, Suite 300, Ann Arbor, MI 48104, USA
e-mail: jcallew@umich.edu

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_14

1 Introduction

Universities throughout the world are actively trying to become more sustainable, in part to reduce their operating costs but also to instill in their students, staff and faculty an understanding of the meaning of sustainability, its importance in a local and global context, and the need for individuals to adapt a more pro-environmental way of life. As part of this effort, universities are initiating programs aimed at conserving energy and reducing their carbon emissions, reducing the amount of material and food wastes, educating faculty and staff as well as students, and both implicitly and explicitly, changing the culture of sustainability on their campuses.

But few universities are undertaking systematic approaches to evaluating the effectiveness of these various initiatives other than tracking operating costs or compiling other hard data such as measures of waste tonnage, energy use, bus ridership and so forth.

Many universities around the world have formal sustainability policies and goals that address aspects of sustainability. Within the framework of a 2011 presidential initiative, the University of Michigan (U-M) established a set goals and broad themes around climate action, waste prevention, healthy environments, and community awareness. As part of the community awareness theme, the University states that it will "*pursue stakeholder engagement, education and evaluation strategies toward a campus-wide ethic or culture of sustainability and will invest in multiple actions to educate our community, track behavior, and report progress over time*".[1]

The articulation of the fourth theme of community awareness and its goal of moving toward a campus-wide culture of sustainability reflect U-M's belief that institutions of higher education can play a critical role is bringing about a societal shift toward a more sustainable future. A culture of sustainability has been defined as "a culture in which individuals are aware of major environmental (and social/economic) challenges, are behaving in sustainable ways, and are committed to a sustainable lifestyle for both the present and future" (Marans et al. 2010, 2014).

Mechanisms for bringing about a cultural shift within universities and colleges are varied and complex (see Leal 2015). Under the heading of "Planet Blue," efforts at U-M involve programs to expand recycling and reduce energy use in buildings, encourage alternative modes of travel to/from campus, promote the use of foods from sustainable sources, and introducing the concept of sustainability in coursework throughout the University. Many are voluntary programs such as Planet Blue Ambassadors and Planet Blue Student Leaders and are coordinated though the University's Office of Sustainability and the Graham Sustainability Institute (see Marans et al. 2012).

Whereas these initiatives are seen as essential to creating a more sustainable campus culture, the Cultural Indicators Sustainability Program (SCIP) represents a critical and complementary component of the Community Awareness theme. That

[1]See Callewaert and Marans (2017) for information about the University of Michigan and a detailed discussion a campus-wide integrative assessment process leading to the establishment of the 2011 goals.

is, SCIP is the mechanism for measuring and tracking progress in moving toward a sustainable campus culture at the University of Michigan. It is a multi-year program involving annual web surveys of large samples of students, staff, and faculty. The sample design during the first year (2012) targeted 4400 students (1000 from each undergraduate class and 400 graduate students), 1000 faculty and 1000 staff. In subsequent years, the design called for 2400 students, 750 faculty, and 750 staff.[2] During the first year, over 4000 students responded with a 40.6 % response rate. Student response rates in subsequent years averaged about 22 %. Targeted numbers of faculty and staff were reached or exceeded with response rates averaging around 40 % for faculty and 45 % for staff. The surveys ask questions about awareness, commitment, engagement and actions or behaviors dealing with the University's goals of Climate Action, Waste Prevention and Healthy Environments. Responses to individual questions are combined to create a range of 15 diverse indicators that deal with awareness, behaviors, degrees of commitment, and levels of sustainability engagement.[3]

SCIP was designed to inform U-M administrators responsible for the day-to day operations of the University including its academic programs. At the same time, it was intended to serve as a model demonstrating how behavioral research could be used to address critical environmental issues while assessing and reporting progress toward creating a culture of sustainability in universities generally and within other organizational settings such as cities and corporations.

2 Recent Uses of SCIP

Since its inception in 2012, SCIP has informed University operations in numerous ways. For instance, special reports have been prepared for facility managers in buildings located in selected parts of campus showing behavioral patterns and levels of awareness among building occupants (e.g. Medical Center, North Campus). SCIP data have also informed the University's Plant Operations Energy Management Team outreach activities which were not having much impact on staff and faculty in terms of understanding their buildings' energy use and awareness of University's efforts to improve the energy efficiency in those buildings. Furthermore, the SCIP data have been reported in newsletters and email blasts to the Planet Blue Ambassadors and Planet Blue Student Leaders suggesting where progress has been made and where greater efforts were needed. Selected operational units have also seen that the level of understanding of certain aspects of sustainability has not

[2]In order to ensure that the responses each year represent the correct proportions of undergraduate and graduate students and faculty-staff ratios, sample weights were developed and used in the analysis of the data.

[3]Callewaert and Marans (2017) present a more comprehensive overview of the Sustainability Cultural Indicators Program (SCIP).

changed among students, faculty, and staff since the surveys were initiated. Finally, the SCIP data have been made available to faculty at U-M and elsewhere for classroom use.

3 Using SCIP to Test New Initiatives

Because of the longitudinal nature of SCIP, it has become increasingly evident that data from the program could be used in other ways including the evaluation of impacts of new sustainability initiatives throughout the University. That is, SCIP data collected before and after an intervention could reveal if and by how much change has occurred in selected behaviors or levels of awareness of the University's sustainability efforts such as those dealing with energy conservation, waste reduction, or environmental protection.[4]

For more than a decade, U-M has initiated numerous sustainability programs designed to conserve energy, reduce waste, and change behaviors of students, faculty, and staff. In some cases, the programs have proved successful and continue to flourish. In other instances, they have been discontinued.[5]

A recent energy conservation initiative by the University's Plant Operations was intended to inform building occupants about building energy use and conservation measures in one cluster of buildings prior to the collection of the 2015 survey. Unfortunately, the initiative lacked cooperation of all facility managers and was aborted. The initiative included placing lobby boards at the buildings' entrances comparing each buildings energy use with that of all campus buildings, floor posters, presentations at staff meetings of units occupying those buildings, and a "neighborhood" lunchtime open house where all employees from the clustered buildings would be invited to view displays, answer questions, and partake in a free meal. At the present time, a team of students is working with Plant Operations to re-design their informational program, plan an experimental intervention including its components, and determine how future SCIP data can be used to evaluate it.

[4]For an experimental design, a control group of people and or places is required whereby no intervention would take place. Comparing outcomes between the control and experimental groups would determine if the intervention targeting the experimental group is having an impact. For a discussion of control groups and the planning of experiments, see Campbell and Stanley (1963).

[5]One initiative that proved ineffective and was eliminated was an energy-saving signage campaign throughout the University. The signs were designed to encourage students, faculty and staff to save energy by having them "Use Your Power Wisely". A pilot study in five University buildings revealed that few occupants recognized the signs when presented to them in a questionnaire and for those who did recognize the signs, a limited number had read them (Marans and Edelstein 2010). Had the signs been first tested in the pilot buildings rather that printing and posting them through the University's 450 buildings, there could have been a savings of several thousand dollars.

Similarly, a graduate level course is being planned whereby students, working with operations personnel throughout the University, would develop ideas for other sustainability initiatives that might be tested with SCIP future years.

In 2015, several new initiatives were recommended as part of a series of sustainability reports to the University's new President.[6] While some of the recommended initiatives are relatively inexpensive and easy to implement, others require substantial planning, start-up time, and financial resources to implement them. For cases where initiatives would relative easy and inexpensive to implement, annual SCIP data could be used to demonstrate to decision makers whether the initiative accomplished what it was intended to do. If it had not done so, the initiative could be discontinued with relatively little cost to the University. However, in the case where recommended new initiatives require substantial resources in terms of time and money, it would seem prudent to set up trials or experiments in one part of campus or in one or two buildings, evaluate their impacts, and based on the evaluation, determine whether the trial should be extended to other parts of the campus, modified, or discontinued. SCIP data could be instrumental in making that assessment. One such initiative deals with composting.

4 Composting in Residence Halls

In recent years, food composting has become an increasingly important vehicle for waste reduction at U-M. For undergraduate students, it has been actively promoted in the newly remodeled dining facilities within the residence halls. SCIP questions about composting were first asked in the 2014 surveys.[7] At that time, only a third of the undergraduate student body was aware of the University's efforts to promote composting. Few staff and even fewer faculty members knew about what the University was doing re: composting.[8] In the 2015 SCIP report, the percent of undergraduate students who know about composting increased to 39 % with more than half of the freshmen saying they were "very aware" or "somewhat aware" of the University's efforts to promote composting. Most of these freshmen were living in the residence halls.

[6]Three committee reports were prepared for U-M's new president in 2015. The University of Michigan (2015a) reports covered landfill waste reduction, greenhouse gas reduction, and sustainability culture. The latter with its recommendations can be found at: http://sustainability.umich.edu/media/files/Sustainability-Culture-Committee-Report-2015.pdf.

[7]Composting was not viewed as an important component of the University's waste reduction program by the advisory team guiding the design of the initial SCIP questionnaires. Subsequent discussions with University personnel dealing with waste and food services resulted in the addition of four questions on composting.

[8]See Appendix Table C15 of the third year SCIP report covering 2014 findings (Marans and Callewaert 2015).

According to the report to the President covering waste reduction, "composting, the managed decomposition of organic material into a nutrient-rich soil amendment, is an integral component to reaching the University of Michigan's waste reduction goal".[9] Currently, only a small amount of the University's compostable waste is diverted from landfills. Much of that waste is food scraps coming from dining facilities in residence halls. In efforts to expand composting beyond the dining halls into other parts of the students' living-learning environment, it was decided to launch a pilot or trial program in one of the University's residence halls. The pilot project was conceived by the University's vice president for Student Life (SL) in collaboration with the Graham Sustainability Institute and would take place in Bursley Hall, one of the largest co-ed residence halls. Bursley Hall was built in 1967 and houses approximately 1270 students, most of whom are first-year students.

5 The Composting Experiment

The pilot program was planned and is being implemented by a team of Planet Blue Student Leaders under the guidance of key staff from SL and the Graham Institute. The program, launched at the beginning of the winter semester (January, 2016) involves enlisting participants who were Bursley residents during the 2015–16 academic year. The participants regularly collect their individual food scraps or other compostable material and deposit them in a composting container located in a waste closet nearest their room.[10] The residence hall custodians would collect the compost material daily and take it to building's Waste Center (along with recyclables and other trash) where it is weighed weekly prior to its being picked up by a private industrial composting company. In order to encourage participation, a competition was established between volunteers living in the east wing of Bursley and those living in the west wing. At the end of the first month of the experiment, nearly 100 students had volunteered to participate (more from Bursley East) and approximately 150 lb of composting material was collected.

6 The Evaluation Plan

As shown in Fig. 1, there are two models for evaluating the impact of the Bursley composting experiment. The first model labeled **Residence Hall Change** considers the impact of the experiment on residence halls whereas the second model examines

[9]The University of Michigan (2015a) report covering waste reduction can be found at: http://sustainability.umich.edu/media/files/Landfill-Waste-Reduction-Committee-Report-2015.pdf.

[10]Student volunteers were given small buckets with removable disposable liners to collect their composting material and guidelines as to what was compostable and what was not. In addition to food scraps, paper products such as napkins, paper toweling, plates, and cups are also compostable.

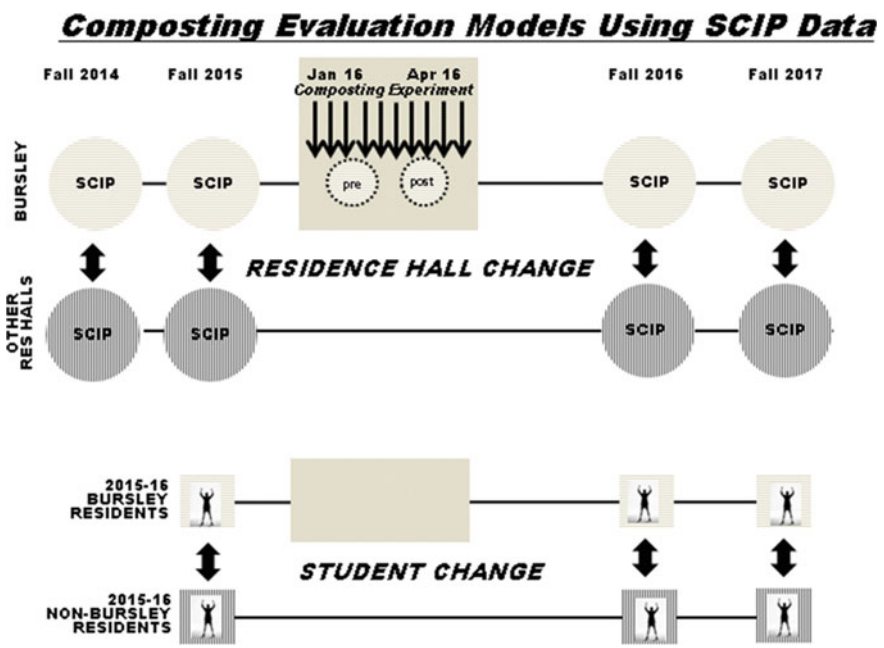


Fig. 1 Composting evaluation models using SCIP data

the impact of the experiment on individual students over time (**Individual Student Change**).

In the Residence Hall Change model, the plan shows that prior to the experiment, SCIP data covering survey participants in Bursley Hall are compared to survey participants in other University residence halls. Specific data to be compared cover students' general understanding of composing, their composting behavior, and their aware of U-M's efforts to promote composting. It is hypothesized that for there would be no significant differences between students in Bursley and those living in all other undergraduate residence halls in both the 2014 and 2015 surveys.

During the 3-month intervention period (January–April), short surveys are administered to all Bursley residents at two points in time. The first (pre) survey, administered a few weeks after the pilot composting program was launched, would determine whether or not students had volunteered to compost and for those who had, the difficulties they were having in doing so. Students who had not participated in the composting experiment were asked why they had not done so. Both participants and non-participants were asked the SCIP questions covering-their overall understanding of composting, their composting behavior, and their awareness of U-M's composting efforts. A similar short (post) survey would be administered to Bursley students prior to their leaving the residence hall at the end of the semester in late April.

The Residence Hall Change model shows that SCIP data collected in the fall 2016 and fall 2017 would compare Bursley Hall residents with residents living in other undergraduate residence halls. The expectation is that as a result of the experiment, Bursley residents would be most likely to (a) know more about composting, (b) engage in composting, and (c) be more aware of what U-M was doing to promote composting on campus.[11]

In the Individual Student Change model shown in the lower half of Fig. 1, the emphasis is in tracking 2015–16 Bursley residents over the next two years. Some of these students are expected to be participants in the composting experiment while many others will not have participated. There is also the possibility that some will remain in Bursley as sophomores in the 2016–17 year.

In the 2016 and 2017 SCIP surveys, students would be asked where they had previously lived while at U-M. It is hypothesized that because of the experiment, those who lived in Bursley during the 2015–16 academic year would be more aware composting at U-M and more likely to engage in composting than students who had not exposed to the Bursley composting program and experience.[12]

7 Current Status

Since the Bursley experiment is currently in progress, we have no way of knowing its impact until survey data are collected at the end of the academic year and in future years. However, we are able to look at earlier SCIP data covering composting at Bursley and at the other U-M residence halls. Figure 2 shows that in 2014, our expectation was correct in that there were no significant differences between Bursley residents and students in other residence halls in their understanding of composting, their awareness of U-M's efforts to promote composting, and the frequency of their composting food scraps.

However, the SCIP data collected in 2015 indicate that students in Bursley were much more knowledgeable about composting, were significantly more aware of the University's effort to promote it, and were more likely to compost food scraps than students in the other residence halls. It is not clear whether these changes are attributable to discussions of the experiment early in the school year when the SCIP

[11]Although it is difficult to know how many of the current Bursley Hall students will return to live there during the next academic year (2016–17), none will be living there during the 2017–2018 academic year since Bursley is designated as primarily a freshmen residence hall with some students choosing to remain there during their sophomore year. Nonetheless, it is expected that the effects of the well-publicized Bursley composting program will carry over in time showing a greater understanding of composting, more composting, and more aware of composting at U-M than what would be found in other U-M residence halls.

[12]The 2015 SCIP data indicate that, most University freshmen (96 %) live in a residence hall and 17 % of them reside in Bursley Hall. Assuming future SCIP surveys target the same number of sophomores and juniors as in the past, (350 each), there will be approximately 60 future respondents who were Bursley Hall residents at the time of the experiment.

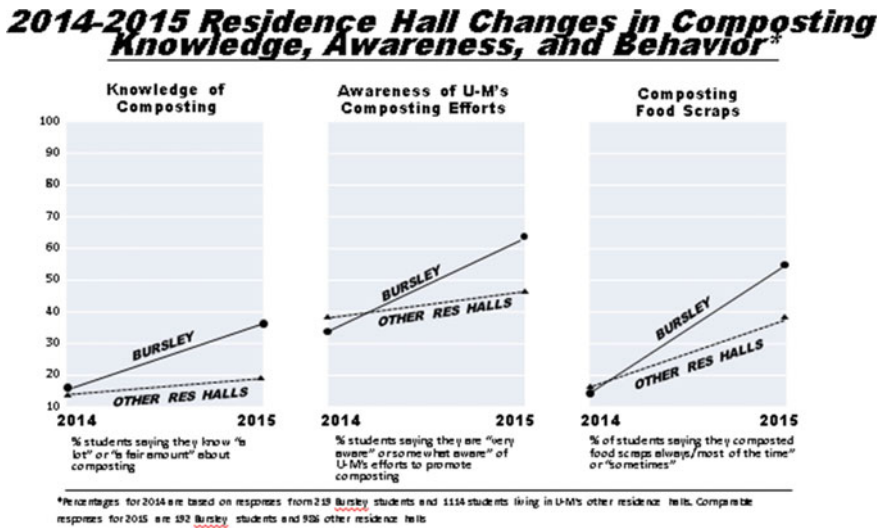


Fig. 2 2014–2015 residence hall changes in composting knowledge, awareness, and behavior

survey was administered, the zeal of the Bursley housing, custodial, and dining staff, or a prevalence of a new cohort of sustainability-minded Bursley students. However, it does suggest that first, Bursley students were much more aware of and engaged in composting than students in other residence halls and second, there was generally a greater understanding of and engagement in composting among all residence hall students between 2014 and 2015. Therefore, the initial hypothesis should be modified to suggest that as a result of the experiment, there will be a greater positive change in understanding, awareness, and composting behavior in Bursley in future years than improvements in other U-M residence halls.

8 Future Scenarios

At this time, it is unclear what direction U-M's Student Life (SL) officials will take with composting in resident halls beyond the current academic year. One scenario is that no decisions will be made regarding an expansion of the composting program. In this instance, the Bursley composting intervention may or may not continue during the next academic year. If it were to continue, short surveys similar those administered in February and April 2016 could be administered, the results of which would be used in determining the next steps.

Another scenario is that based on findings from the short surveys conducted at the beginning and end of the current experiment, the composting program could be modified and introduced in other residence halls. Responses to the SCIP questions asked in the short surveys would be compared to earlier SCIP surveys which

presumably would show a greater understanding of composting and a higher level of engagement in composting practices.

A third scenario is to expand the experiment beyond Bursley into one or two additional residence halls during the 2016–17 academic year. The experimental composting program would be modified based on findings from the 2016 short surveys. The longer term evaluation would be based SCIP data collected in 2017. The evaluation would then compare data from Bursley and the added experimental residence halls with the non-experimental (control) residence halls where composting is limited to their dining facilities.

9 Summary

The composting experiment at Bursley represents the first sustainability initiative on the U-M campus that can be evaluated systematically using SCIP data. The benefits of doing so can result in not only incremental learning but in significant financial savings to the University. Should the experimental composting program prove successful in terms of a greater understanding of composting, more students engaged in composting, and a significant amount of composting material being collected and diverted from landfills, an expanded composting program could move forward throughout more University residence halls. If, however, the Bursley experiment proves unsuccessful, the University's Office of Sustainability and Student Life need to re-think the role of composting as part of the University's waste prevention efforts, how it might be modified, and whether it should be continued throughout University Housing and elsewhere.

As previously mentioned, SCIP has large representative samples of faculty, staff and students each year enabling the clustering of respondents in buildings and groupings of buildings. Such clustering presents opportunities to conduct experiments or trial programs similar to the composting experiment described in this chapter.

Acknowledgments In preparation of this paper, we acknowledge the analytical assistance of Minako Edgar for ISR's Survey Research Center and cooperation of the U-M's Student Life office. In particular, the impetus for the experiment came from Student Life's, Keith Soster, Director of Student Engagement for Michigan Dining. He and a team of Planet Blue Student Leaders implemented the experiment. Key players among the Student Leaders were Elizabeth Makuch and Joseph Hansel. The former contributed to background for this paper while the latter played a key role in administering the pre and post-surveys during the winter semester, 2016.

References

Callewaert, J., & Marans, R. W. (2017). Measuring progress over time: The sustainability cultural indicators program at the University of Michigan. In W. Leal Filho (Ed.), *Handbook of theory and practice of sustainable development in higher education* (Vol. 2). Berlin: Springer.

Campbell, D., & Stanley, J. (1963). *Experimental and quasi-experimental designs for research*. Boston: Houghton Mifflin Co.

Leal, W. L. (Ed.). (2015). *Transformative approaches to sustainable development at universities*. Switzerland: Spring International Publishing.

Marans, R. W., & Callewaert, J. (2015). Monitoring the culture of sustainability at the University of Michigan; Fall 2015 http://graham.umich.edu/media/files/SCIP-Year-3-Report.pdf

Marans, R. W., Callewaert, J., & Shriberg, M. (2012). Creating and assessing a campus culture of sustainability: The University of Michigan experience. In W. Leal (Ed.), *Sustainable development at universities: New horizons*. Frankfurt: Peter Lang Scientific Publishers.

Marans, R. W., & Edelstein, J. (2010). Human dimensions of energy conservation and sustainability: A case study of the University of Michigan's energy conservation program. *International Journal of Sustainability in Higher Education, 11*(1), 6–18.

Marans, R.W., B. Levy, B. Bridges, K. Keeler, T. Avrahami, J. Bennett, & et al. (2010). Campus sustainability integrated assessment: Culture team phase I report. Retrieved from:http://www.graham.umich.edu/pdf/culture-phase1.pdf

University of Michigan. (2015a). Report for President Schlissel from the Committee on the Culture of Sustainability at the University of Michigan. http://sustainability.umich.edu/media/files/Sustainability-Culture-Committee-Report-2015.pdf

University of Michigan. (2015b). President's Committee on Landfill Waste Reduction. Recommendations Report. http://sustainability.umich.edu/media/files/Landfill-Waste-Reduction-Committee-Report-2015.pdf

Authors Biography

Robert W. Marans Ph.D is Research Professor at the University of Michigan's Institute for Social Research and Professor Emeritus of Architecture and Urban Planning in the university's Taubman College of Architecture and Urban Planning. For more than three decades, he has conducted evaluative studies and research dealing with various aspects of communities, neighborhoods, housing, and parks and recreational facilities. His research has focused on user requirements and the manner in which attributes of the physical and sociocultural environments influence individual and group behavior and the quality of community life. Dr. Marans' most recent book, *Investigating Quality of Urban Life: Theory, Methods, and Empirical Research* was published by Springer (2011). His current research considers the impact of the built and natural environments on quality of life, the role of neighborhood in the health of Detroit residents, and issues of sustainability and energy conservation in buildings and institutional settings. He and Dr. Callewaert are co-principal investigators of SCIP.

John Callewaert Ph.D is Integrated Assessment Director at the Graham Environmental Sustainability Institute and a Lecturer in the College of Literature, Science, and the Arts at the University of Michigan. As Integrated Assessment Program Director of the Graham Institute, Dr. Callewaert is responsible for designing, implementing and overseeing the day-to-day operations for the Integrated Assessment (IA) Program—the Graham Institute's engaged problem solving/translational research initiative. Dr. Callewaert came to the Graham Institute in 2009 after serving for two years as the Director of the University of Michigan-Flint Office of Research. From 2000 to 2007, Callewaert was the founding director of the Institute for Community and Environment at Colby-Sawyer College and an Associate Professor of Social Sciences and Education. Between 1984 and 1987 he served as an agricultural volunteer with Peace Corps Nepal working on improving seed supplies in remote hill villages. Dr. Callewaert serves as an associate editor for the Journal of Environmental Studies and Sciences and as an advisory board member for The Integrated Assessment Society. Dr. Callewaert earned a B.S. in Agricultural Engineering Technology from Michigan State University and his Ph.D. from the School of Natural Resources and Environment at University of Michigan-Ann Arbor.

Evaluation of a Transdisciplinary Research Project for a Sustainable Development

Andrea Heilmann and Sophie Reinhold

Abstract

One major aim of student education is the integration of students in research and development projects for a sustainable development especially in master and Ph.D. programs. Sustainability research should be based on a transdisciplinary approach in order to reach the aim of shaping real processes into a sustainable society. Due to the high complexity of the problem statement as well as the various perspectives of the related stakeholders concerning everyday life and scientific problems, for evaluating transdisciplinary research projects appropriate methods and procedures are required. Through the realization of the evaluation, factors of success can be determined. The paper is going to introduce different methods that can be sub-classified into process evaluation and performance evaluation. Process evaluation looks at the research process itself whereas performance evaluation assesses the results and benefits in comparison with the everyday life problem. Both methods will be applied on a case study for sustainable regional development. Thereby, the integration of heterogeneous stakeholders in the evaluation process will be of particular importance.

Keywords

Sustainable development · Transdisciplinary research project · Evaluation · Model project

A. Heilmann (✉) · S. Reinhold
Department of Automation/Computer Sciences, Harz University of Applied Sciences, Friedrichstraße 57-59, 38855 Wernigerode, Germany
e-mail: aheilmann@hs-harz.de

S. Reinhold
e-mail: sreinhold@hs-harz.de

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_15

1 Introduction

> Sustainable development will not be brought about by policies only: it must be taken up by society at large as a principle guiding the many choices each citizen makes every day, as well as the big political and economic decisions that have to be taken. This requires profound changes in thinking, in economic and social structures and in consumption and production patterns. (EU 2015)

Universities train the executives from tomorrow. This means they have to give graduates the necessary knowledge as well as the methodically abilities and competencies which enable them to contribute to a sustainable development. An essential approach for solving relevant problems is the transdisciplinary research approach.

Transdisciplinary research is mainly characterized thereby that researchers of different disciplines working jointly with practical experts to examine real everyday life problems (Bergmann et al. 2005). At the beginning of transdisciplinary research there is a problem of everyday life which has to be solved. For practitioners it is of particular importance that the solution of the everyday life problem is focused. Pohl et al. (2011) states that the specific purposes of the project have to be clearly identified.

The participation of students especially of master and Ph.D. programs in multi- or transdisciplinary research projects can support the development of necessary qualifications and also can contribute to the conversion of the student requirement profiles (EHEA 2005).

> Students should apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study. (EHEA 2005)

Within the scope of the study new methodical approaches have be provided for transdisciplinary research and projects. These methods are manifold and require knowledge as well as practical experience.

The following article describes a research project for the development and conversion of a municipal sustainable concept. The aim is to determine factors of success for transdisciplinary research projects. Therefore different evaluation methods are used.

2 Structure of Transdisciplinary Research Projects

According to Bergmann and Schramm (2008) the transdisciplinary methods can be distinguished between two purposes, namely between an action method within the research process as well as in representation methods for the research object (problem). In addition, a division is carried out between pragmatic-intuitive, principle-escorted and formal methods.

A transdisciplinary research project mainly consists of three project phases (Fischer et al. 2015; Pohl and Hirsch Hadorn 2006):

1. Problem identification and structuring as well as derivation of a general research object
2. Problem treatment and in value settlement as well as subject related knowledge generation
3. Conversion of the results/integration.

Bergmann et al. (2005) described the ideal type of a transdisciplinary research process which has been also applied for the model project. Characteristically for the process is the differentiation of the general research object in sub-questions. These sub-questions are worked on in single teams. These sub-teams consist of researchers as well as of practitioner. The essential perceptions are made available to all other stakeholders for discussion and further usage (integration). The project management ensures the compatibility between the various parts of the project. Finally, impulses are expected for changes in practice and innovations in science (intervention).

In the result of a transdisciplinary research process a final evaluation generates the bases for a continuous improvement process. Evaluation and quality control are therefore essential elements of the processes and projects. Through the evaluation the project course (process evaluation) on the one hand or the achieved results on the other hand can be judged.

Transdisciplinary research follows a participatory approach. Since the sustainability research represents a wide field of social, ecological and economic issues the involvement of different stakeholders (academics and non-academics) is indispensable. Important is the heterogeneity of the stakeholders as all of them contribute their experiences and knowledge and have different methodological approaches. This aspect of cooperation and participation should be also integrated and trained during the study.

The above mentioned arguments regarding methodical approaches as well as participation underline that an integration of transdisciplinary research projects in student education is essential and will become even more important in the future. Especially in the research fields of sustainability and climate mitigation adaptation where several stakeholders—practitioners and scientists—are involved the approach of transdisciplinarity will increase.

3 Description of the Model Project for a Sustainable Regional Development (“ZukunftsWerkStadt”)

The model research project was divided into two funding phases 2012/2013 and 2014/2015 supported by the German Federal Ministry of Education and Research for driving sustainable urban development.

The project aimed to develop a long-term sustainability strategy for the model community the city of Osterwieck situated in the Harz county. Osterwieck has approximately 12,000 inhabitants and was formed from formerly independent municipalities of 20 small districts in 2010 to the new unity municipality "city of Osterwieck" (Osterwieck 2016). In dependence of the rather rural structure of the city of Osterwieck and its related characteristics, the fields of action for the sustainable strategy were defined.

The sustainable strategy consists of six fields of action:

- Participation, which allow stakeholders to take over direct responsibility and self-determining for single projects
- Reliable services for the public, carried out by different regional stakeholders
- Energy saving and application of renewable energy
- Environment protection and nature conservation
- Sustainable economy, which considers resource protection and is aiming on the preservation/support of the regional, varied economic structure as well as reliable services for the public
- Universal, social challenges.

In all fields of action either specific research was conducted or capacity building and public awareness was improved. New approaches regarding participation were tested in order to consider the specific regional context.

The project was scientifically assisted by the Harz University of Applied Sciences. One important characteristic of the project was that many local institutions and citizens representing different disciplines and sectors have been involved. Moreover, students were involved in sub-projects which could be connected to their field of study. They were involved in sub-projects and were responsible for surveys, project modeling and evaluation processes.

The model project is a suitable example for transdisciplinary research as it met the main characteristics mentioned in chapter "Process Evaluation" (Bergmann et al. 2005):

- Problem orientation and translation—examine everyday life problems to shape real processes:
  The research project concentrated on the following questions: "How do we want to live? How do we need to economize? How can we preserve our environment?". The first question is dealing with solutions for rural areas and their problems concerning the effects of demographic changes. The main sub-topics of the project were energy—living—environmental protection—mobility as well as the development of the inner city and the strengthening of the public participation. For single areas detailed research questions were developed. For the other areas an improved transfer of knowledge was realized. Continuous networking was given through regular project meetings and the project own participation platform www.vision20plus.de.

- Stakeholder orientation:
  The stakeholders which have been involved in the project represented inhabitants, local authorities, enterprises and NGOs. They had a strong influence by defining research and development goals, by providing information, by taking responsibility for the implementation and participating in the evaluation. An essential result of the model project was the improved cooperation of all stakeholders and the willingness to support such an overlapping process in the long-term.
- Transdisciplinary orientation concept:
  Considering the scientific view, an essential result is the development of regional defined sustainability indicators which allow stakeholders for the first time an integral decision base. The evaluation criteria are partly based on the results of the research topics.
- Context-relatedness:
  An essential aspect of the model project was the consideration of the regional conditions and specifications. The mutual influence also with further aim dimensions of a sustainable development was considered among other things by the indicator development and by the adaptation and use of the multi-criteria assessment method PRIMATE. In addition, the methodical instruments are available for other decision-making processes in the region and after adaptation also in other regions.

4 Description of the Applied Evaluation Methods

Based on the state of the discussion and a literature review Pohl et al. (2011) summarized that "currently, there are no widely established and approved criteria and procedures to evaluate inter- and transdisciplinary research." The working paper distinguishes the applied methods regarding the three major purposes of inter- and transdisciplinary research which are: fundamental understanding, problem solving and reflection-in-action. The problem solving is recently often used for the development and implementation of environmental or sustainable strategies (Pohl et al. 2011). Problem solving was also the main purpose within the model project.

Wiesmann et al. (2008) state that external evaluation and internal quality control of transdisciplinary projects pose a great challenge. It is recommended that the evaluation should go beyond traditional reference systems.

For the evaluation of the described transdisciplinary research project two different groups of methods were used: process evaluation and performance evaluation in a long and short term perspective (see Fig. 1). The process evaluation examines the process itself. This could be either the compliance with the main characteristics of a transdisciplinary project (Bergmann et al. 2005) or with the requirements regarding a process of continuously improvement. The performance evaluation on

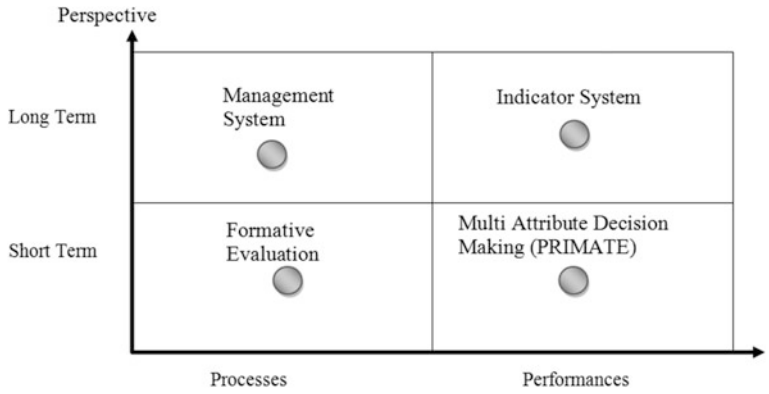


Fig. 1 Overview about the applied evaluation methods

the other hand considers the outcome in relation to real problems and the integration of heterogeneous stakeholders. Both evaluations can have a short or a long term perspective. A principle overview is given by Fig. 1.

4.1 Process Evaluation

4.1.1 Formative Evaluation

For the evaluation of good transdisciplinary research projects a guideline "Quality Criteria of Transdisciplinary Research" has been developed by Bergmann et al. in (2005). This guideline describes four main characteristics which support recognizing transdisciplinary research projects:

- Problem orientation and translation—examine everyday life problems to shape real processes
- Stakeholder orientation—the involvement of various non-academic stakeholders is an essential characteristic of transdisciplinary research projects
- Transdisciplinary Orientation Concept—describes the integration of different disciplines and practical insights, to realize this characteristic suitable approaches and methods have to be applied
- Context-Relatedness—for a successful implementation of project results legal frameworks and possible actions have to be considered (Bergmann et al. 2005).

For evaluating whether the above mentioned criteria are met, the mentioned guidance was used which embodies different basic and detailed criteria. Deviating from the recommended discursive-formative procedure a questionnaire with 20 questions was compiled. This questionnaire was completed by only four stakeholders (two from science and practice). Therefore, only qualitative trends can be derived from the results.

4.1.2 Internal Audits

Given a transdisciplinary research process societal changes shall be derived. Hence, new questions can result which again can lead into a further transdisciplinary research process. This requires a structured procedure to follow up the changes in the real practice comparable to internal audits within environmental management systems.

This continuous improvement process is an essential element of environmental management systems. For the evaluation, internal audits are carried out:

> … 'internal environmental audit' means a systematic, documented, periodic and objective evaluation of the environmental performance of an organisation, management system and processes designed to protect the environment (EU 2009).

Through regular audits, in particular by questioning the stakeholders, it can be determined whether processes for conversion transdisciplinary cooperation over a long period have emerged. In the model project the internal audits were carried out in the form of problem-centered and guideline-supported interviews of all stakeholders involved in the project. In the result 11 interviews with a duration of approx. 45 and 90 min were conducted.

4.2 Performance Evaluation

Considering the performance evaluation this paper will focus on two types of performance evaluation which has been used in various projects.

4.2.1 Preference Ranking Organisation Method for Enrichment Evaluation (PROMETHEE)

The first one is the Preference Ranking Organisation Method for Enrichment Evaluation short PROMETHEE which has been developed in the eighties. This method aims for solving multi-criteria based decision problems. Thus, the PROMETHEE method enables a comparison given various alternatives and different scaled criteria as well as the integration of more than one decision maker using pair wise relations between different alternatives. This method is applied under the assumption that the preferences of the decision maker are uncertain. Hence, the method tries to generate a transparent decision making process so the decision maker has to look at the decision problem in detail and is able to rethink his/her preference. In the result one receives a ranking order of the alternatives. Given the rank order and the transparent decision process it is more likely to bring about a decision which is acceptable for all involved parties. The variability of the rank order can be proved through a sensitivity analysis (Geldermann and Lerche 2014).

For the evaluation of sustainable and climate adaptation measures the Helmholtz Centre for Environmental Research has generated a process flow (see Fig. 2) and a software called PRIMATE (BMVBS 2013).

In order to compare different solution options with respect to the real everyday life problem the participants develop besides economic criteria a set of sustainable

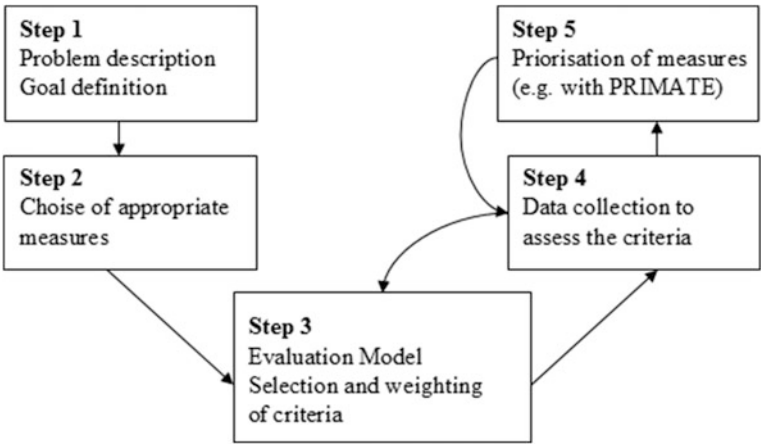


Fig. 2 Process flow of a multi-criteria decision making process. Adapted from Gebhardt et al. (2012)

criteria as well as weighting factors. Thereby it is not only possible to consider all relevant sustainability aspects—irrespective of what nature they are, whether monetary, quantitative or qualitative—also meanings, attitudes and preferences of various decision makers can be integrated. Stakeholder participation plays an important role within this method.

Within the model project three courses of actions in the areas of supporting participation, the supply with convenience goods and energy savings were compared by employing the PROMETHEE method in connection with the PRIMATE software.

4.2.2 Sustainable Indicators

The second performance evaluation method which will be considered is an evaluation given indicators which are the basis for sustainability reports. Indicators deliver a value which can be compared and thus support decision makers finding a suitable decision. Indicators aggregate information which simplifies complex issues. The usage of sustainability indicators increases the comparability of sustainable actions and developments (United Nations 2007).

Moreover, the application of sustainable indicators at the regional level is gaining more importance. According to Gehrlein (2004) sustainable indicators and target systems combine respectively integrate the mostly unrelated side by side existing control processes at political, administrative and technical level. The use of such an indicator system can lead to a raised effectiveness and efficiency in the municipal control (Gehrlein 2004).

Within the scope of the strategy development 18 strategic sustainable indicators have been developed for the model region. These were underpinned with concrete objectives for 2020 as well as key indicators. An evaluation of target achievement was not possible within the scope of the project therefore, it requires a long-term

consideration. However, within the scope of an audit it was analyzed, whether the chosen indicators were suitably, practicable and understandable for the citizens to recognize and support the linked approach.

5 Results of the Evaluation: Model Project ("ZukunftsWerkStadt")

5.1 Performance Evaluation

5.1.1 Formative Evaluation

The questionnaire has been separated into four subject complexes, whose essential insights are summarized (under recognition of only four respondents).

A division in scientific and life-worldly questions is visible for all interviewees and is also named uniformly. The comprehensive and linked processing under inclusion of varied stakeholders is seen as a factor of success. Furthermore, it is emphasized positively that through the inclusion of research partners new methodical procedures/instruments are shared and therefore can be used.

The technical composition of the team as well as the project structure is suited to achieve the aimed comprehensive targets. It needs to be aware of the fact that already at project beginning the practice partners need to know the necessary complexity. From the point of view of the practice partners the solution of a problem mostly stands in the center of the work, the scientific innovation is a tool which is used when required.

The very short term of only two years complicates a clear structuring of the process into milestones on which the single sub-projects are brought together regularly. More resources are required. This also relates to the necessary measures for the key to success. The results of transdisciplinary cooperation are estimated by all interviewees as very positive. Concerning the transferability and the continuation of a sustainable regional development with integration of various stakeholders it is expelled that long term structures are necessary in the municipal management.

5.1.2 Internal Audits

For a successful realization of a sustainable regional development a continuous control and monitoring in connection to the aims is required. Eleven stakeholders from science and local practice were interviewed.

Besides the evaluation of the single measures it encompasses the consideration of the chosen sustainable indicators which was realized with surveys and data evaluations, comparable to an internal audit. Thus, qualitative results were achieved.

It turned out that beyond the administration of the city of Osterwieck the sustainability concept and the used indicators are known only slightly. The citizens preferentially are interested in information about projects and areas which are from personal interest. A development of general thinking and decision making should be

continuously supported. The use of the indicators as a control and decision instrument within the administration can still be improved. The interconnection between different departments of the administration is an indispensable presupposition.

Concerning the successful assessment of the single sub-projects it was clearly visible that the sub-projects have woken up the consciousness of the citizens for the subject of sustainable development and the willingness to further work on a sustainable development.

Furthermore, with the help of the internal audit it was examined, to what extent the interweaving of the levels could be realized (Multi-Level-Governance was set up). In this area there is still clear potential of improvement. The particular importance of a coordinating position was stressed several times. This coordinating position should be able to link up stakeholders from practice and science and to initiate continuing transdisciplinary research processes.

5.2 Performance Evaluation

5.2.1 Preference Ranking Organisation Method for Enrichment Evaluation (PROMETHEE)

The PROMETHEE method was applied in order to priorities alternative sub-projects for a sustainable development in the region. These projects were worked out by different teams. In order to compare the alternatives the stakeholders discussed and finally defined the weighting factors which correlate with step 3 (see Fig. 2). The criteria and the weighting factors are compiled in Table 1.

Table 1 Set of criteria, used for PRIMATE

Main criteria	Weighting factors (%)	Sub-criteria impact on …	Weighting factors (%)
Ecology	15	Environmental effects	25
		Biodiversity	25
		Energy saving potential	25
		Resource protection potential	25
Economy	55	Effect duration	20
		Costs	30
		Support of regional economy	20
		Increase of employees	10
		Number of benefitting people	20
Social aspects	30	Health effects	14.28
		Education/advanced training	14.28
		Demographic change	14.28
		Participation	14.28
		Social relationships/cooperations	14.28
		Local affinity/hold potential	14.28
		Cultural contribution	14.28

The weighting indicates a preference for one criteria group—the economic criteria. The resulting ranking order should be proved by a sensitivity analysis. This analysis exposes the uncertainties which have to be considered during the decision making process. In order to increase the acceptance for the project results, this method should be applied regularly. Moreover, the integration of all stakeholders should be assured. The results have to be communicated to the public in suitable and understandable way.

5.2.2 Sustainable Indicators

The compiled indicator ensemble shows a meaningful municipal supplement to the indicators of the federal and communal level. The comparison with indicator-sets of other regions as well as the evaluation of the stakeholder interviews supports this statement. Single indicators have been adapted, because either the influence on the development of the indicator is not given by the municipal administration or on the other hand the effort for the inquiry is too high. The time frame of the model project was too short for the performance evaluation. The goals which have to be met are in the mid-future so that this performance could not be assessed within the project. Therefore structures are required to monitor the long-term process.

6 Conclusions

This article describes a project for regional sustainable development and the applied methods for evaluation and quality control. The model project can be classified as a transdisciplinary project even though only limited research issues are addressed. Main efforts were put on problem solving and decision making processes.

Through the usage of various project evaluation methods and the comparison of the results with other projects, the following factors of success were identified:

- method knowledge ready to use and experiences in using the methods,
- interconnection of all stakeholders in every project phase by different activities (for example through workshops, online platform, massage boards),
- continuous supply of information for all stakeholders during the project term and also after the end of the project,
- sufficient resources (in particular time, financial and personal resources) and
- sufficient project term and continuous advancement also after the end of the project.

Taking into consideration the complexity of transdisciplinary research as well as the different experiences and expectations of the stakeholder from both sides—science and practice—it is obvious that different and overarching methods for evaluation should be applied. Several classifications regarding evaluation methods are possible (internal and external, process and performance, for short or long life span). The methods should be adopted and enhanced in order to increase the

experience and the acceptance. Wiesmann et al. (2008) also pointed out, that the most important corner stone for further enhancing transdisciplinary research is improving its practice.

The formal evaluation and the internal audits showed that the various stakeholders have to become more familiar with the transdisciplinary research approach. Therefore, education and training in that field is necessary. Hence, the first step is the integration in study programs to prepare students for their future positions.

Nevertheless, all stakeholders recommend the cooperation between science and practice for a general subject; however the essential aim of the cooperation is the solution of a concrete, often specialist subject. The assessment of different solutions concerning the aim reaching can occur by the use of PROMETHEE. This method illustrates that different solutions may contribute to an overall objective and encourage the transdisciplinary thinking.

All applied methods within the model project are based on transdisciplinary assessment. The more practical experiences are existent, the higher the acceptability will be for transdisciplinary research. Therefore students should be trained to disseminate new approaches.

The active participation of stakeholders from science and practice is decisively for the success of transdisciplinary research in general. However, it is also important especially for the evaluation procedures. The cooperation of the involved actors has to be planned carefully. Various formats for supporting the interconnection are necessary (for example workshops, design-thinking, online-platforms).

Hence, the project plan should include enough time and resources for participation. Therefore, it can be also concluded that transdisciplinary research requires a certain project term. A time period of one year as in the model project was a very short time horizon for it.

In addition, the within the project begun change processes should be continued and evaluated after the project end. Internal audits and sustainable indicators offer good opportunities. All these measures require structures and resources which should be available for a long period.

The challenges which arise by transdisciplinary research are only successfully manageable if the necessary method knowledge is imparted in the study and is applied as often as possible.

References

Bergmann, M., Brohmann, B., Hoffmann, E., Loibl, M. C., Rehaag, R., Schramm, E., et al. (2005). Quality criteria of transdisciplinary research. Institute for Social-Ecological Research (ISOE), Frankfurt am Main, ISOE-Studientexte, No. 13, 7–16.

Bergmann, M., & Schramm, E. (2008). *Transdisziplinäre Forschung - Integrative Forschungsprozesse verstehen und bewerten* (pp. 69–91). Frankfurt/Main: Campus-Verlag. http://www.transdisciplinarity.ch/documents/Pohl_Hirsch_inBergmannSchramm08.pdf. Last accessed January 11, 2016.

BMVBS. (2013). Bewertung und Priorisierung von Klimaanpassungsmaßnahmen. Leitfaden zur Entscheidungsunterstützung bei der urbanen Klimaanpassung. BMVBS-Online-Publikation 11/13, Hrsg.: BMVBS, Juli 2013. http://www.bbsr.bund.de/BBSR/DE/Veroeffentlichungen/BMVBS/Online/2013/ON112013.html?nn=423048. Last accessed January 16, 2016.

EHEA. (2005). *European Higher Education Area (EHEA): The framework of qualifications for the European Higher Education Area* (p. 2). http://www.ehea.info/Uploads/Documents/QF-EHEA-May2005.pdf. Last accessed January 20, 2016.

EU. (2009). Regulation (EC) No 1221/2009 of the European Parliament and of the Council of November 25, 2009 on the voluntary participation by organisations in a community eco-management and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC. http://eur-lex.europa.eu. Last accessed January 11, 2016.

EU. (2015). *Sustainable development*. http://ec.europa.eu/environment/eussd/. Last accessed January 17, 2016.

Fischer, D., Grunenberg, H., Mader, C., & Michelsen, G. (2015). Transdiziplinäre Bildungsforschung für nachhaltige Entwicklung. In W. Leal Filho (Hrsg.), *Forschung für Nachhaltigkeit an deutschen Hochschulen* (pp. 25–42).

Gebhardt, O., Brenck, M., Meyer, V., & Hansjürgens, B. (2012). Entscheidungsunterstützung bei der urbanen Klimaanpassung. Ökonomische Bewertung und Priorisierung von Anpassungsmaßnahmen am Beispiel der Stadt Sangerhausen, Landkreis Mansfeld-Südharz. Helmholtz-Zentrum für Umweltforschung – UFZ: o.O, 5.

Gehrlein, U. (2004). *Nachhaltigkeitsindikatoren zur Steuerung kommunaler Entwicklung* (p. 6). Wiesbaden: VS Verlag für Sozialwissenschaften.

Geldermann, J., & Lerche, N. (2014). *Leitfaden zur Anwendung von Methoden der multikriteriellen Entscheidungsunterstützung*. Methode: PROMETHEE (pp. 11–53). http://www.uni-goettingen.de. Last accessed January 07, 2015.

Osterwieck. (2016). *Unsere Einheitsgemeinde Stadt Osterwieck*. http://www.stadt-osterwieck.de/unsere-einheitsgemeinde-stadt-osterwieck. Last accessed January 16, 2016.

Pohl, C., & Hirsch Hadorn, G. (2006). *Gestaltungsprinzipien für die transdisziplinäre Forschung. ein Beitrag des td-net* (pp. 83–64). München: Oekom-Verlag.

Pohl, C., et al. (2011). Questions to evaluate inter- and transdisciplinary research proposals. Working paper, TD-net for Transdisciplinary Research, Berne.

United Nations. (2007). *Indicators of sustainable development: Guidelines and methodologies* (3rd edn., p. 3). http://www.un.org/esa/sustdev/natlinfo/indicators/guidelines.pdf. Last Accessed January 07, 2015.

Wiesmann, U., Hirsch Hadorn, G., Hoffmann-Riem, H., Biber-Klemm, S., Grossenbacher, W., Joye, D., et al. (2008). Enhancing transdisciplinary research: A synthesis in fifteen propositions. In G. Hirsch Hadorn, H. Hoffmann-Riem, S. Biber-Klemm, W. Grossenbacher-Mansuy, D. Joye, C. Pohl, et al. (Eds.), *Handbook of transdisciplinary research*, chapter 27 (pp. 433–441). Dordrecht: Springer.

Author Biographies

Professor Andrea Heilmann holds a University Diploma in Water Engineering (Dipl.-Ing. Uni) from the Dresden University of Technology (1990). She took her doctoral degree in the field of waste management at Dresden University of Technology (1999). From January 1991 to September 2000 she worked as a consultant in waste management. Since 2000, she has been a Professor in Environmental Management and Technology at the Harz University of Applied Sciences. Her research focusses on climate protection and adaptation as well as on sustainable development.

Sophie Reinhold born in 1986, holds a Master of Science in Management from the Otto-von-Guericke University Magdeburg (2012) and a Bachelor of Arts in International Business from the Anhalt University of Applied Sciences (2009). For her master degree she examined the influences of institutional frameworks on corporate social responsibility activities of companies. From 2012 to 2015 she has been a research associate at the Harz University of Applied Sciences in Wernigerode. Here she worked on different projects focusing on sustainable development and climate adaptation.

Munich University of Applied Sciences Towards a "Whole Institution Approach"—Illustrations Along x-Disciplinary Perspectives to Education for Sustainable Development

Sascha Zinn and Ralf Isenmann

Abstract

Munich University of Applied Sciences (MUAS) is developing education for sustainable development (ESD) as a strategic issue and based on a sound methodology, in contrast to a one-off effort as most fashionable short term projects and pick and mix approaches. Thereby MUAS follows a long term development path to incorporate sustainability across all areas and fields of action. This overall incorporation of sustainability as an integral part in MUAS is exactly what the UN Global Action Program calls "whole institution approach", highlighted and emphasized in priority action area 2 (UNESCO in UNESCO Roadmap for implementing the global action programme on education for sustainable development. UNESCO, Paris, 2014). Further to a number of measures already taken and launched in MUAS, the central questions around ESD are: Which approaches may offer proper teaching and learning settings to make sustainability actually work? How to implement ESD into academic curricula, informal learning opportunities in students' day life, and local urban environments? The sound methodology used to investigate the totality of realizations of ESD implementations and to identify the proper ones for MUAS is the morphological box. It provides a powerful heuristic tool for creative problem solving, particularly applied to explore all realizations of multi-dimensional, non-quantifiable phenomena—like ESD. As a result, the morphological box delivers a systematic overview, covering all possible ways with hundreds of different options and various opportunities on how ESD could be realized in the light of relevant attributes in the field of ESD (Isenmann and

S. Zinn (✉) · R. Isenmann
Sustainable Future Management, Faculty of Business Administration, BMBF-Project, Munich University of Applied Sciences, Am Stadtpark 20, 81243 Munich, Germany
e-mail: sascha.zinn@hm.edu

R. Isenmann
e-mail: ralf.isenmann@hm.edu

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_16

Zinn in Morphological box for education on sustainable development—approach and examples at the Munich University of Applied Sciences, 2015). With the help of the morphological box the full range of options and opportunities to make ESD actually work could be illustrated in detail, so that any university—or any other educational institution—may find its customized profile of ESD courses. To describe ease of use of the morphological box, the full range of opportunities to make ESD actually work is illustrated along the four different approaches of x-disciplinarity (Isenmann in Interdisziplinarität: verstehen—verantworten—gestalten, Institut fächerübergreifenden Studierens und Forschens (LfSF), Trier, 1999; Isenmann and Zollner in Nachhaltigkeit in der x-disziplinären Lehre. Beispiele zum Einbezug von Nachhaltigkeitsthemen in die Betriebswirtschaftslehre mit Erfahrungen an der Hochschule München, Transcript, Bielefeld, 2014)—i.e. monodisciplinarity, multidisciplinarity, interdisciplinarity and transdisciplinarity. Each approach is described through corresponding ESD course formats at MUAS. Further, the overall inter- and intra-organizational embeddedness of sustainability in MUAS is pointed out.

Keywords

Education for sustainable development (ESD) · Morphological box · x-Disciplinarity · Whole institution approach · Transdisciplinarity · Interdisciplinarity · Multidisciplinarity · Monodisciplinarity · Munich University of Applied Sciences (MUAS)

1 Munich University of Applied Sciences Towards a "Whole Institution Approach"

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 various options, but at the same time 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 subject's mathematics, computer science, natural sciences and engineering, business administration, social sciences and public health as well as in architecture and design both, at bachelor and master level.

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.

1.1 Institutional Embedding of Sustainability

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.

2 Morphological Box—Sound Methodology to Investigate the Totality of Realizations of ESD Implementations

2.1 General Morphology Analysis (GMA)

As 'morphology' comes from the antique Greek term 'morphe', which means shape, form or Gestalt, morphology is the study of form or pattern. More specified morphology calls for the arrangement of the parts of an entity and how these 'conform' to create a whole or "Gestalt" (German). The subject of study can be physical objects, social objects or mental objects. Nowadays, the morphological method is used in scientific disciplines that focus more on the formal structure than on the quantitative description (Ritchey 2013).

> Attention has been called to the fact that the term morphology has long been used in many fields of science to designate research on structural interrelations – for instance in anatomy, geology, botany and biology. (…) I have proposed to generalize and systematize [sic] the concept of morphological research and include not only the study of the shapes of geometrical, geological, biological, and generally material structures, but also to study the more abstract structural interrelations among phenomena, concepts, and ideas, whatever their character might be (Zwicky 1969, p. 34).

General Morphological Analysis was introduced and developed by Fritz Zwicky as a method for structuring and investigating the total set of relationships contained in multidimensional, non-quantifiable, problem complexes (Zwicky 1969, 1969;

Müller-Merbach 1976 with many applications). Non-quantifiable means that the objects of investigation contain strong social, political and cognitive dimensions. Furthermore, the multiple network connections and hence the non-linearity of social systems means that literally everything is connected with everything else. "(…) within the final and true world image everything is related to everything, and nothing can be discarded a priori as being unimportant" (Zwicky 1969).

The basic assumption of morphological analysis is that even when the social, organizational and political systems cannot be quantified they can be synthesized into well-defined relationships or configurations, which represent 'solution spaces'. "Essentially, general morphological analysis is a method for identifying and investigating the total set of possible relationships or 'configurations' contained in a given problem complex" (Ritchey 2013, p. 3).

3 Morphological Analysis for the Implementation of ESD at Universities

Morphological Analysis begins by identifying and defining the parameters (or dimensions) of the problem complex to be investigated. The centerpiece of the morphological analysis is an n-dimensional matrix, also known as the morphological box. The first column of the matrix shows all independent values. In the remaining columns all possible conditions of these values are shown. "Each cell of the n-dimensional box contains one particular 'value' or condition from each of the parameters, and thus marks out a particular state of configuration of the problem complex" (Ritchey 2013, p. 3).

In our case: 'Education for Sustainable Development at Universities' we can think of independent values such as 'level of action' and specify conditions like 'cross-university', 'university wide', 'cross faculty', 'faculty specific'…. When we proceed in this way we get a comprehensive matrix (Table 1).

This total set of possible relationships is called the morphological field. Every combination of the different parameters produces a theoretically possible 'solution' for the problem complex. "The next step in the analysis-synthesis process is to reduce the total set of (formally) possible configurations on the problem space to a smaller set of internally consistent configurations representing a 'solution space'" (Ritchey 2013, p. 5). Zwicky named this the principle of contradiction and reduction. The process of contradiction and reduction is also known as "cross-consistency assessment" (CCA) (ibid.). CCA refers to the insight that numerous parameters of the morphological field are mutually inconsistent. In total there are three types of inconsistencies: "purely logical contradictions (i.e. those based on the nature of the concepts involved); empirical inconsistencies (i.e. relationships judged to be highly improbable or implausible on empirical grounds), and normative constrains (e.g. relationships ruled out on e.g. ethical or political grounds)" (ibid. p. 6). In this context it's important to be aware of the fact that the cross-consistency assessment is not about normative judgement. At this point of the

Table 1 Morphological box describing ESD implementations at universities

Value	Parameter value				
Level of action	Cross-university	University wide	Cross-faculty	Faculty specific	…
Degree programme	Doctoral degree	Bachelor	Master	Advanced training certificate	…
Curricular embedding	Mandatory modules	Compulsory elective subject	Elective subject	Non-curricular	…
Crediting	Credit points	Without certificate (regular degree performance)	Credit points with certificate	Certificate without credit points	…
Type of mediation	Classroom course	'Out of box' course	Blended learning	Online course	…
Disciplinary approach	Monodisciplinary	Multidisciplinary	Interdisciplinary	Transdisciplinary	…
…					

process no consistent possibility should be excluded. "We must first investigate what is possible, before making judgments about what is, and what is" not, desirable" (ibid.).

Through the connection of the remaining parameters theoretical possible solutions can be created. This formalization is a schematic and playful method to find innovative ways of 'problem solving'. For example, the line in Table 1 shows online courses as they are created by the University of Bremen in the Virtual Academy of Sustainability (http://www.va-bne.de). Through this formalization it is possible not just to think about the theoretical solutions but also about the possibilities of institutional embedding. So in this specific example the visualization through the morphological box made it clear that the best chance for the curricular embedding of the virtual academy for sustainable development is along the other elective subjects in the department for general studies.

The morphological box "may help us to discover new relationships or configurations, which may not be so evident, or which we might have overlooked by [sic] other—less systematic—methods. Importantly, it encourages the identification and investigation of boundary conditions, i.e. the limits and extremes of different contexts and factors" (Ritchey 2013, p. 8).

4 Illustrations Along the Disciplinary Approach

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 2009, 2012; Gonçalves et al. 2012; Starik et al. 2010). Among others, the four principles of disciplinarity open up a range of opportunities for ESD (Isenmann 1999; Isenmann and Zollner 2014; Table 2):

- *Monodisciplinarity* stands for a perspective where sustainability issues are studied from a single and standalone discipline. For example, the faculty of business administration offers an advanced course on "sustainability management" highlighting the economic point of view and emphasizing business opportunities including managerial issues.
- *Multidisciplinarity* describes a method of approaching sustainability with the background of a few disciplines just added but without any linkages or substantial exchange. Multidisciplinarity can be characterized as*: juxtaposing, sequencing and coordinating* (Thompson Klein 2012). Lectures series, perhaps on climate change or on "Energiewende" are examples where different faculties shed some light to a common and shared challenge viewed through various disciplinary lenses.
- *Interdisciplinarity* additionally reflects differences as well as shared perspectives in scientific disciplines such as specific foci, certain methodologies, and heterogeneous basic assumptions. For interdisciplinarity, these scientific basics between and "inter" disciplines are explicitly reflected and taken into account. Interdisciplinarity can be characterized as: *integration, interacting. linking, focusing and blending* (ibid.).
- *Transdisciplinarity* aims to transform the orthodox disciplinary orientation towards an overarching synthesis. Transdisciplinarity is a scientific principle, which particularly comes into effect when the present problems cannot be solved within a single discipline (Jungert 2013). 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

Table 2 Synopsis of x-disciplinarity (Isenmann and Zollner 2014)

Characteristics	Monodisciplinarity	Multidisciplinarity	Interdisciplinarity	Transdisciplinarity
Perspective	Single academic perspective	Just adding academic perspectives	Linking academic perspectives	Contextualizing academic perspectives
Exchange with scientific experts	Within scientific community and within scientific borders	Within the "academic closed-job"; scientific labor division	Also considering specific features of scientific perspectives, i.e. "disciplinary lenses"	Also considering goals, objectives, purposes
Further co-operation	–	–	–	Permanently and continuously: problem definition, selection of proper methods, transfer of results and implementation
Process	*State of the art*, i.e. traditional problem solving	Traditional isolated labor division and problem solving	Common problem solving, intensive co-operation across disciplines and communities, review and reflection across disciplinary boundaries	Also reflection with external parties outside academia and knowledge exchange with stakeholders from the "Lebenswelt"
Result	Traditional scientific contribution: *rigor*	Addition of various scientific contributions	"Übersumma-tivität"	Purposeful contribution, of *relevance* in terms of sustainability and taking into account: human, social and ecological compatibility
Slogan	*Rigor* first	Broadening disciplinary views and opening single perspectives	Building bridges between various disciplinary views, understanding the common grammar ("inter") of disciplines	*Relevance* first

transformation. Transdisciplinarity can be characterized as: *transcending, transgressing and transforming* (Thompson Klein 2012), while taking into account the three basic sustainability criteria of human, social and ecological compatibility (Isenmann 2008).

No matter which certain approach is actually applied. Each one has its own right and certain qualities. We can picture these different qualities in a continuum between *rigor* and *relevance*. Rigor means proceeding systematically and methodically, it stands for accuracy and precision. Rigor is essential when proceeding according to scientific standards and traditional academic procedures, but it is not everything. Relevance refers to the application of core knowledge, concepts or skills to solve real-world problems. Relevance is very close to the concept of competencies. This continuum doesn't represent a contradiction. In fact, they are interdependent and mutually reinforce each other. Even if the correlation between these two items were highly interesting and profitable, this is not the place to refer to it. However, taking this continuum we can provide a descriptive understanding of the relation between Monodisciplinarity, Multidisciplinarity, Interdisciplinarity and Transdisciplinarity.

Another model to help us understand the difference between the different approaches is the T-model (Isenmann and Zollner 2014). The vertical bar stands for profound professional knowledge. This knowledge is taught in monodisciplinary courses. This axis focuses on rigor. The horizontal bar of the T represents interdisciplinary competencies. Relevant learning is inter- and transdisciplinary. The main focus of this axis is relevance. The T-model will help us to gain a better understanding of the opportunities and challenges arising from the incorporation of ESD along the four principles of x-disciplinarity.

4.1 Illustrating Monodisciplinarity: Sustainability Management

There is a long discourse in the philosophy of science to answer the question for the composition of disciplinarity. As it is not the purpose of this paper to refer to the question of disciplinarity in terms of professional philosophy of science we have to confine ourselves here to merely touching on the topic.

In summary disciplinarity is characterized by a shared (scientific) 'language', a common theoretical basis and a common view of problems as a result of a shared socialization and education (Defila and Di Giulio 1998). This means every discipline has a very specific point of view about the question of how to structure 'reality'.

To illustrate this we can take the picture of 'disciplinary lenses'. The different lenses give us the opportunity to focus on certain parts of reality. As when using a magnifying lens we get a deep insight, we can observe details and structures that we would not be able to identify without focusing. The price for this detailed picture is that other perspectives fade.

Integrating the holistic principle of sustainability into a disciplinary format always means breaking through the disciplinary horizon and broadening the view. Such an approach is offered by the course 'Sustainable Management' at the faculty of business administration of MUAS. The course teaches the students to consider the outcomes of entrepreneurial behavior in respect to man, society and nature. The students should be able to apply the concept of sustainability to corporate practice by adapting the principles to strategy, processes and products.

4.2 Illustrating Multidisciplinarity: Sustainability Reporting

Driven by a worldwide demand for the reform of universities in 1970 the member countries of the Organization for Economic Co-operation and Development (OECD) held the first international conference on problems of interdisciplinary research and teaching. As a result in 1972 the first major interdisciplinary typology was published. In this classification Multidisciplinarity was defined as an approach that juxtaposes disciplines. "Juxtaposition fosters wider knowledge, information and methods. Yet, disciplines remain separate, disciplinary elements retain their original identity, and the existing structure is not questioned" (Thompson Klein 2012).

The benefits and the disadvantages of this approach are obvious: we gain in-depth but discrete insights. By means of the specific subject methodology we attain a high level of rigor, but little relevance.

The advantage of this approach is that it is highly compatible with the vertical structuring of universities into departments. With reference to the T-Model, multidisciplinary courses can clearly be located on the vertical axis. The institutional structure of universities is very similar to the description of Multidisciplinarity: Universities are defined as institutions that juxtapose disciplines. "Juxtaposition fosters wider knowledge, information and methods. Yet, disciplines remain separate, disciplinary elements retain their original identity, and the existing structure is not questioned" (Thompson Klein 2012).

Taking this observation we get an idea why universities are struggling with the implementation of inter- and transdisciplinary research and teaching. On the other hand, we see that Multidisciplinarity can be an intermediate step on the way to more relevance.

At MUAS we pursue the idea of using the potential of a multidisciplinary course to set up a Sustainability Report (SR) for MUAS. Sustainability reporting is a highly relevant topic for universities in Germany. As universities are institutions for the education of policy makers, society demands that they assume special responsibility.

The idea is to connect awareness rising for Sustainability with the specific in-depth skills of the different departments. MUAS has fourteen departments including departments such as 'Architecture', 'Civil Engineering', 'Building Services Engineering', 'Electrical Engineering and Information Technology', 'Computer Science and Mathematics' and 'Applied Social Science'.

Because of a full subject curriculum many of these departments have great difficulties integrating new topics such as sustainability. By working on a Sustainability Report we can address these faculties with their in-depth knowledge and bring in sustainability as the generic term. For example we can ask a cement engineer to examine the building materials and to place his findings into the SR. In doing this, he and his students first have to deal with the special requirements of a SR and get in touch with Sustainability.

4.3 Illustrating Interdisciplinarity: The Art of Sustainable Decision Making

Interdisciplinarity (ID) is a dazzling term—a buzzword with many different meanings. Heckhausen (1972) differentiates six different forms of ID. As the theoretical analysis of ID is not the focus of this paper we just note that the 'litmus test' for ID is integration and interaction of disciplines.

With reference to the T-model we now reach the horizontal bar. As illustrated above this horizontal orientation does not fit the structure of scientific institutions such as universities. In fact, real integration and interaction between different disciplines would lead to a transformation of the disciplines participating in the interdisciplinary process itself. But as we know from system theory, systems like disciplines (institutionalized in departments) have a tendency for self-preservation (Parsons). Important for this self-preservation is the protection of the disciplinary borders through the regulation of the transformative tendencies inside the system. In addition to these systemic constraints interdisciplinary collaboration has to deal with numerous practical difficulties (Sukopp 2013). But despite all these difficulties with Interdisciplinarity, there is no alternative. The global challenges of the present do not end at the borders of disciplines.

At MUAS we are in the fortunate position of having a department for 'General and Interdisciplinary Studies'. At the department for 'General and Interdisciplinary Studies' students from the other departments get the opportunity to learn about different topics in addition to their main subject of study. A department like this offers great opportunities for the implementation of ESD.

"The art of sustainable decision making" aims to foster systemic thinking. An important part of the systemic approach is the development of interdisciplinary explanation patterns. Through the use of a broad methodology such as simulation games, action learning, discussion of dilemmas, etc. we encourage a shift in perception. The students have to take different roles such as those of politicians, members of NGOs, lobbyists etc. and have to represent these positions and put them across in joint negotiations representative of real life situations. The goal is to develop an integral view and to reflect one's own (subject) perspective.

4.4 Illustrating Transdisciplinarity: ZukunftGestalten@HM

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 of 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.

Such a transdisciplinary approach is currently labelled as so-called "real laboratory – in 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 exceptional role within society, in particular by contributing to sustainable development (Beynaghi et al. 2014; UNESCO 2014; Leal Filho 2011).

The flagship course "ZukunftGestalten@HM—Future City" provides an excellent example of a transdisciplinary approach in ESD (Isenmann et al. 2016). 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.

The scope of the course in the summer term 2015 was to investigate how future cities may look in general, and, more specifically, how the city of Munich should be developed in terms of sustainability. 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, hence their efforts to provide sustainability solutions merit greater effort. As a tangible, local and real-life example we had focused on 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 a specific area 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 with 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 on strategic urban planning and development projects.

As an "urban real lab", "ZukunftGestalten@HM—Future City" is a hands-on seminar and real-life project. The students participating in the project in the summer term 2015 were from eight different faculties, such as 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. In this way, we made sure that the students do not just engage in interdisciplinary interaction within the group, but also with their coaches. The interdisciplinary configuration of the teams across faculties and the 'inter-disciplinary' assistance offered by two coaches from different faculties is the 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.

5 Conclusions and Recommendations

Powered by the UN Decade for ESD in the period 2005–2014 and the Global Action Program as its follow-up, ESD has become one of the most noticeable developments for universities' development, today. While more and more universities have taken up ESD as an integral part of a whole institution approach, many are still seeking for guidance on how to develop ESD in practice. The window of opportunities for implementing ESD is now open.

Contrary to a one-off effort as most fashionable short term ESD projects are conducted in a pick and mix approach, MUAS follows a long term development path to develop ESD, Using the morphological box helps us to discover new ways of problem solving, in particular to investigate the totality of realizations of ESD implementations and—no less important—finally to identify the proper ones for MUAS. For that reason, we used the powerful heuristic tool of the morphological box. And as a result, the morphological box for ESD delivers a systematic overview, covering all possible ways with hundreds of different options and various opportunities on how ESD could be realized in the light of relevant attributes in the field of ESD. On that basis, customized implementations for MUAS could be developed, established, evaluated and further fine-tuned on a continuous basis. All other universities may use the overall ESD morphological box to develop their unique ESD profiles, while particularly benefitting from experiences of x-disciplinary course formats gained at MUAS. As the overall aim, the contribution attempts to make clear the various opportunities for ESD and its different x-disciplinary facets on the one hand and on the other, examples of current practice and future developments towards a whole institution approach at MUAS are presented.

As important this sound methodology is, we have to bear in mind limiting factors and its boundary conditions. Since the challenges of our time cannot be solved by just one single discipline we are critically dependent on inter- and transdisciplinary collaboration. Hence universities are requested to offer inter- and transdisciplinary education. In order to achieve these objectives, the traditional structures of universities, 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 2015).

An example for such a structural element is a common time-slot for interdisciplinary courses. Only a free time-slot scheduled in any faculty provides the opportunity for collaboration across faculties. The fact, that MUAS has put a shared, weekly, university-wide time-slot into the timetable for all bachelor degree courses is a great improvement for ESD at MUAS.

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 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.

GMA has definite advantages for strategic and scientific communication. Using the morphological box for the implementation of ESD at universities provides a systemic, clear and traceable foundation for the development process. Furthermore the morphological box can be used to give answers to questions of institutional embedding, the analysis of the status quo and much more.

GMA is a very fundamental method that leaves open a number of questions about the qualities and dependencies of the independent variables. The assessment of the different ways of problem solving requires comprehensive expert knowledge, but used properly the method is versatile and rich.

Acknowledgments This contribution is an outcome of the project: "Für die Zukunft gerüstet" (German, Future proof), funded by the Federal Ministry of Education and Research (BMBF), grant no. 01PL11025. This overall support is gratefully acknowledged.

References

Bergmann, M., Brohmann, B., Hoffmann, E., Loibl, M. C., Rehaag, R., Schramm, E., et al. (2005). *Quality criteria of transdisciplinary research. A guide for the formative evaluation of research projects*. Frankfurt/M.: Institute for Social-Ecological Research (ISOE).

Beynaghi, A., Moztarzadeh, F., Maknoon, R., Waas, T., Mozafari, M., Huge, J., et al. (2014). Towards an orientation of higher education in the post Rio +20 process: How is the game changing? *Futures 63*, 49–67.

Defila, R., & Di Giulio, A. (1998). Interdisziplinarität und Disziplinarität. In J. H. Olbertz (Ed.), *Zwischen den Fächern – über den Dingen? Universalisierung versus Spezialisierung akademischer Bildung* (pp. 111–137). Opladen: Leske und Budrich.

Federal Ministry of Education and Research (BMBF). (2015). *Ideen für die Stadt der Zukunft*. Available online http://www.bmbf.de/de. Accessed February 15, 2015.

Funtowicz, S., & Ravetz, J. (1993). Science for the post-normal age. *Futures, 25*(7), 735–755.

Fraunhofer. (2014). *Morgenstadt city labs. Accelerating the sustainable development of cities*. Study prepared by A. Radecki. Stuttgart: Fraunhofer-Institute for Industrial Engineering IAO.

Gonçalves, F. J., Pereira, R., Leal Filho, W., & Miranda Azeiteiro, U. (Eds.) (2012). *Contributions to the UN decade of education for sustainable development* (Vol. 33). Environmental education, communication and sustainability. Frankfurt/M.: Peter Lang.

Heckhausen, H. (1972). Discipline and Interdisciplinarity. In L. Aposter, G. Berger, A. Briggs & G. Michaud (Eds.), *Interdisciplinarity. Problems of Teaching and Research in Universities*. Paris: Organisation for Economic Co-operation and Development (OECD).

Isenmann, R. (1999). Interdisziplinarität: verstehen – verantworten – gestalten. In W.-D. Hutter (Ed.), *Interdisziplinarität. Möglichkeiten und Grenzen fächerübergreifender Lehre und Forschung* (pp. 17–43). Trier: Institut fächerübergreifenden Studierens und Forschens (LfSF).

Isenmann, R. (2008). Sustainable information society. In M. Quigley (Ed.), *Encyclopedia of information ethics and security* (pp. 622–630). Hershey (PA): IGI Global.

Isenmann, R. (2013). Eine Professur für eine nachhaltige Hochschule. Interview mit Prof. Dr. Ralf Isenmann, Inhaber der Professur für nachhaltiges Zukunftsmanagement an der Hochschule München. *Hochschulen für eine nachhaltige Entwicklung. Ideen zur Institutionalisierung und Implementierung* (pp. 22–23). Deutsche-UNESCO-Kommission. Bonn: VAS.

Isenmann, R., & Zinn, S. (2015). Morphological box for education on sustainable development—approach and examples at the Munich University of Applied Sciences. In V. Dermol, A. Trunk, & M. Smrkolj. (Eds.), *Managing intellectual capital and innovation for sustainable and inclusive society: Proceedings of the Make Learn and TIIM Joint International Conference, 27–29 May 2015, Bari, Italy*. Bangkok et al.: ToKnowPress. Available online http://www.toknowpress.net/ISBN/978-961-6914-13-0/MakeLearn2015.pdf. Accessed June 03, 2015.

Isenmann, R., & Zollner, G. (2014). Nachhaltigkeit in der x-disziplinären Lehre. Beispiele zum Einbezug von Nachhaltigkeitsthemen in die Betriebswirtschaftslehre mit Erfahrungen an der Hochschule München. In C. Schier, & E. Schwinger (Eds.), *Interdisziplinarität und Transdisziplinarität als Herausforderung akademischer Bildung. Innovative Konzepte für die Lehre an Hochschulen und Universitäten* (pp. 123–137). Bielefeld: Transcript.

Jahn, T., Bergmann, M., & Keil, F. (2012). Transdisciplinarity: Between mainstreaming and marginalization. *Ecological Economics, 79*, 1–10.

Jandrić, P. (2014). Research methods are made by questioning: The postdisciplinary challenge of networked learning. In S. Bayne, C. Jones, M. de Laat, T. Ryberg, & C. Sinclair, C. (Eds.), *Book of selected papers from the Networked Learning 2014 conference* (pp. 162–169). New York: Springer.

Landeshauptstadt München. (2013). *PERSPEKTIVE MÜNCHEN – Fortschreibung 2012. Ergebnisse der Öffentlichkeitsbeteiligung. Leitmotiv, strategische Leitlinien*. Landeshauptstadt München. Referat für Stadtplanung und Bauordnung. Available online www.muenchen.de. Accessed January 24, 2015.

Leal Filho, W. (Ed.) (2009). *Sustainability at universities—opportunities, challenges and trends* (Vol. 31). Environmental education, communication and sustainability. Frankfurt/M.: Peter Lang.

Leal Filho, W. (Ed.) (2011). *World trends in education for sustainable development* (Vol. 32). Environmental education, communication and sustainability. Frankfurt/M.: Peter Lang.

Leal Filho, W. (Ed.) (2012). *Sustainable development at universities: New horizons* (Vol. 34). Environmental education, communication and sustainability. Frankfurt/M.: Peter Lang.

Müller-Merbach, H. (1976). The use of morphological techniques for OR-approaches to problems. In *Operations Research '75* (pp. 127–139). Amsterdam, New York, Oxford: North-Holland Publishing Company.

Nationale Plattform Zukunftsstadt (NPZ). (2014). *NPZ-Konferenz –Session 11: Reallabore für Forschung und Umsetzung*. Available online http://www.nationale-plattform-zukunftsstadt.de. Accessed February 14, 2015.

Rat für Nachhaltige Entwicklung (RNE). (2014). *Ergebniszusammenfassung der RNE-Bildungskonferenz "Vom Piloten zum Standard: Nachhaltigkeit in Forschung, Lehre und Betrieb implementieren"*. Available online www.nachhaltigkeitsrat.de. Accessed January 26, 2015.

Ritchey, T. (2013). General morphological analysis. A general method for non-quantified modelling. Available online www.swemorph.com. Access January 15, 2016.

Schneidewind, U. (2014). Urbane Reallabore – ein Blick in die aktuelle Forschungswerkstatt. *pnd| online III*: (pp. 1–7). Available online www.planung-neu-denken.de. Accessed February 14, 2015.

Scholz, R., Lang, D., Wiek, A., Walter, A., & Stauffacher, M. (2006). Transdisciplinary case studies as a means of sustainability learning. *International Journal of Sustainability in Higher Education, 7*(3), 226–251.

Starik, M., et al. (Eds.) (2010). Academy of management learning and education. *Special Issue: Sustainability in Management Education 9*(3).

Sukopp, T. (2013). Interdisziplinarität und Transdisziplinarität. Definitionen und Konzepte. In M. Jungert, E. Romfeld, T. Sukopp, & U. Voigt (Eds.), *Interdisziplinarität. Theorie, Praxis, Probleme* (pp. 13–30). Darmstadt: Wissenschaftliche Buchgesellschaft.

Thomson Klein, J. (2012). A taxonomy of interdisciplinarity. In R. Frodelman, J. Thompson, & C. Mitcham (Eds.), *The Oxford handbook of interdisciplinarity* (pp. 15–30). Oxford: Oxford University Press.

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2014). *UNESCO Roadmap for implementing the global action programme on education for sustainable development*. Paris: UNESCO.

University Educators for Sustainable Development (UE4SD). (2014). *Mapping opportunities for professional development of university educators in education for sustainable development: A state of the art report across 33 UE4SD partner countries*. In M. Mader, D. Tilbury, J. Dlouhá, J. Benayas, G. Michelsen, C. Mader, et al. (Eds.), Cheltenham: University of Gloucestershire.

Zwicky, F. (1969). *Discovery, invention, research—through the morphological approach*. Toronto: The Macmillan Company.

Zwicky, F., & Wilson, A. (Eds.). (1967). *New methods of thought and procedure: Contributions to the symposium on methodologies*. Berlin: Springer.

Author Biographies

Dr. Sascha Zinn is Research Assistant at the professorship for Sustainable Future Management, Faculty of Business Administration at the Munich University of Applied Science. As a educationalist specialized in adult education and Education for Sustainable Development he is in charge of developing innovative teaching approaches and a concept for Education for Sustainable Development for the Munich University of Applied Sciences. Supported by a scholarship from the "Foundation of the German Economy" he did his dissertation at the University of Würzburg in 2012. In Würzburg he studied education, sociology and psychology. His main research is focusing on higher education, organizational development and sustainable future management.

Prof. Ralf Isenmann is a Professor for Sustainable Future Management, Faculty of Business Administration, Munich University of Applied Sciences, and an Associate Professor for Business Administration, Institute for Project Management and Innovation, University of Bremen. Prior, he was a Professor for Sustainability Management, Faculty of Business Studies, Management and Economics, University of Kassel. Further, he was a Senior Researcher and Project Manager at the Fraunhofer Institute for Systems and Innovation Research ISI, Karlsruhe. His research areas include the various facets of education for sustainable development (ESD), in particular the interface between sustainability management, industrial ecology, corporate social responsibility (CSR), and business ethics on the one hand, and the management of technologies and innovation on the other. He holds a Master Degree in Industrial Engineering, Business Studies and Management (Dipl.-Wirtsch.-Ing.) and a Ph.D. from the University of Kaiserslautern and a habilitation (venia legendi) from the University of Bremen.

Part II
Integrated Sustainability Practices

A Brazilian University Facing Challenge of Education for Sustainable Development

Deisi Viviani Becker, Simone Alves Pacheco de Campos and Tania Nunes da Silva

Abstract

Universities are working more and more every day to be the locus for efforts to enable them to enact management alternatives towards sustainable development and at the same time, to make their students be in touch with the most developed management tools, taking into account the intertwined "environmental, social, and economic" spheres. The following research shows the different phases that the Federal University of Rio Grande do Sul experienced regarding their relationship with sustainable development. It was necessary to: (a) check what the institutional plans regarding the issue are; (b) understand the way managers of the Environmental Management System (EMS) work and carry out their plans and (c) realize way of integrating sustainability into the curriculum of higher education. In the last decade, the difficulties and obstacles have shown that the process is delicate and slow. Even without an official document that provides clear directions to all institutional levels, there are initiatives that impact on best practices within the University and end up reflecting positively in society. From this work, other institutions can benefit from the initiatives and have the awareness that the process of change, although difficult, can happen gradually and gain legitimacy.

D.V. Becker (✉) · S.A.P. de Campos · T.N. da Silva
Management School, Federal University of Rio Grande do Sul, Washington Luiz, 855, Porto Alegre, Rio Grande do Sul, Brazil
e-mail: deisibecker@bol.com.br

S.A.P. de Campos
e-mail: simoneapcampos@gmail.com

T.N. da Silva
e-mail: tania.silva@ufrgs.br

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_17

Keywords
Education for sustainable development · University · Policies · Challenges · Brazilian University

1 Introduction

Universities have come to encompass much more than research and teaching purposes, challenging the traditional management model (Chambers and Walker 2016). Sustainability and Sustainable Development have been frequent subjects in all kinds of discussions. Thereafter, it is recognized that any social movement towards these subjects requires change. In order to build a real sustainable university, that is committed to global concerns, universities are working more and more every day to be the locus for efforts to enable them to enact management alternatives towards sustainable development and at the same time, to make their students be in touch with the most developed management tools, taking into account the intertwined "environmental, social, and economic" spheres.

The studies on sustainable development cover many discussions about water, efficiency, garbage, waste, global warming, pollution, environmental awareness, social inclusion. According to Leal Filho et al. (2015, p. 01), "a university campus is a unique combination of buildings, geographical locations, types of faculties, research institutes, and students", for this reason, the attention to such issues at universities is increasing and the classroom needs to be shaped by institutional examples.

Many institutions around the world are redesigning and trying to improve their processes to reduce the significant impact that a university promotes and "integrating sustainable development as part of their programs in a holistic way" (Leal Filho 2015, p. 10). This paper is concerned with exploring some of the obstacles and challenges faced by a Brazilian University in implementing a sustainability agenda. The obstacles here can be understood as institutional frameworks and strategies and their impacts in actors' initiatives involved in creating a sustainable campus. Our intention here was to investigate these obstacles and challenges in relation to five categories: operations, strategy, institutional plans, actors' knowledge about institutional declaration of sustainability, and future plans. We believe these categories of analyses can show us a clear picture of challenges and obstacles faced by an Educational Institution in its journey to sustainable development.

The Federal University of Rio Grande do Sul (UFRGS) started the process on sustainable development in 2005. With nine members, a selected group of teachers and administrative staff formed the initial drive to achieve the sustainable

development policies. The process has developed over the years and was regulated according to rules and regulations. The University is working to transform the difficulties and challenges in propellants to build a future connected with economic, social, and environmental responsibilities in the educational sphere.

However, results show that the process is still emerging in UFRGS. Even though eleven years have passed, few actions were really put in practice by the educational institution. There are many reasons associated to this institutional inertia but, in this case, the biggest problem was the lack of an institutional strategy that involves the whole university. It is important to consider that the campus greening processes that have worked in other universities happened upon sustainable development policies planned from the summit, in a top down way. For this reason, the present research aims to understand the way institutional frameworks and institutional strategies can restrict (or frame) actors' educational initiatives towards sustainable development in higher education.

A qualitative case study approach has been drawn, facing obstacles regarding the transition between a traditional educational positioning to a more sustainable one. Some steps were underlined to achieve the research purpose: firstly, we have identified the strategic decisions taken in favour of sustainable development in the Institution. Secondly, we have identified the people who participated in the working group for the implementation of environmental policies at the University. Thirdly, interviews with people in this group were held. Such interviews could outline the history and the strategic space that environmental policies occupy. Fourthly, difficulties in driving the process within the University have been identified.

Our intention was to show the obstacles regarding education for sustainable development. We believe that even without an official document that could provide clear direction to all institutional levels, there were some initiatives impacting the University as a whole. Thus, this is not a success report. Our main objective is to show the obstacles and challenges faced by this educational institution to a sustainable development educational model. From this work, other institutions could benefit from the initiatives and understand that the process of change, although difficult, can happen gradually and gain legitimacy.

The remainder of this paper is organized as follows: the subsequent section comprises a literature review outlining the challenges that Universities face in order to engage in sustainable development educational trajectories and the rise of Greening the Campus. Secondly, we highlight the importance of institutional frameworks and strategies that support and enable transition to the insertion of sustainable development at University institutional levels, in order to improve the educational scenario as well. Then, the findings of the application of the theoretical framework on the case study will be reported. Finally, we wrote some limitations of our work and discussed potential paths for further research.

2 Universities and Ways to Achieve Sustainable Development

The University plays a critical role in equipping students with the knowledge and insight into the most important environmental issues (Figueredo and Tsarenko 2013). And more than equipping them, the University can act being the locus of initiatives and management models that enable their students to be in touch with the best and most developed tools in order to consider the whole, visualize the intertwined "environmental, social, and economic" spheres (Elkington 1999). Some good examples can be cited in Yale University and Columbia University (USA), University of British Columbia (Canada), University of Lüneburg, University Zittau-Görlitz or the Hamburg University of Applied Sciences (Germany), Polytechnic of Barcelona (Spain) and Royal Institute of Technology (Sweden) (Leal Filho 2015, p. 11).

Liskdog and Elander (2010) point out, without detracting the formal set of institutions—such as global agreements, participation of governments—that local initiatives are crucial. Higher education is characterized in the same way as an important agent for this positive change for sustainability, due to its fundamental mission of knowledge generation and transfer through research and teaching (Cebrián et al. 2013). For Sterling et al. (2013), a systemic change and new ways of working are required to achieve a transformational approach to sustainable development.

"A first type of challenge is the incorporation within the own management of university campuses, practices aimed at sustainability. The consumption of materials for research and teaching until the final disposal of waste, the Higher Education Institutions (HEIs) are challenged to rethink their actions and relationships" (Jacobi and Beduschi Filho 2014, p. 128). If we want those actions to be far-reaching and lasting, it is assumed that the participation of higher education institutions (HEI) is crucial to the formation of beliefs and values, as well as the education of individuals who will occupy the position of decision makers in organizations and will be involved in the transition to a more sustainable society (Pereira et al. 2013).

The definition of a sustainable university in the literature always refers to environmental, economic, and social concerns that universities should have on their activities, and the obligation of "*leading by example*" (Amaral et al. 2015). Broadly speaking, a sustainable university should "walk the talk" in regard to its sustainability agenda, i.e. it should teach the concept and philosophy of SD to their students, but it should also be able to embrace the concept within day-to-day organizational management. Analyses of sustainability report content of several universities by different researchers showed that, despite its significance within the university system, educational dimension is the less addressed one (Amaral et al. 2015).

For this reason, it is essential for the university to draw up clear policies to conduct the efforts towards sustainable development. There are many actions that can contribute to the commitment for sustainable development. However, such actions need to be coordinated and have the support of strategic bodies to be continued.

3 Sustainable Universities: From Sustainability in Higher Education to Institutional Levels

In 1987, Sustainable Development was defined by the Brundland Comission, having the concept intensely been adopted as a guide for doing business in the mission statement of many institutions. In the educational sector it was not different. The first declaration of sustainability specifically targeted at higher education was made by the university sector in 1990.

Composed in 1990 at an international conference in Talloires, France, the Talloires Declaration is the first official statement made by the university administrators of a document to environmental commitment in higher education. The Talloires Declaration is a plan for incorporating sustainability literacy in teaching, research, operations, and outreach at colleges and universities. It has been signed by over 350 university presidents and chancellors in over 40 countries (Wright 2002).

According to Grindsted (2011), a total of 31 declarations have emerged, of which 15 have been made by the university sector and 16 by intergovernmental institutions, mainly UNESCO. At a total, more than 1400 universities worldwide have signed some kind of declaration. Several studies show, however, that signing a declaration does not necessarily lead to the implementation of the declaration's principles of sustainability, and that universities have either found themselves unable to implement the declaration's principles or have not made efforts towards their implementation.

The education for sustainability journey has taken us into uncharted territories with new ideas and concepts, and, in turn, many challenges for institutions. According to Leal Filho (2000) the most common challenges are related to: (i) sustainability is, itself, an abstract concept that is not related to academic practice; (ii) there is a lack of experts in Universities to deal with sustainability as a problem; (iii) Universities do not have financial resources; and, (v) sustainability is often treated as a question for environmentalists, without scientific value.

4 Data and Methods of Analysis

In order to understand the way institutional frameworks and institutional strategies can restrict actors' educational initiatives towards sustainable development in higher education, a single case study was performed in an Brazilian Federal

University in order to understand its practices, processes, and the challenges faced by the institution in order to implement institutional strategies to add sustainable development concerns into institutional levels.

Following the proposition by Stake (2000) of a case study typology, we could have rather intrinsic or instrumental case studies. As for intrinsic case study, the case is valid for its particular value; it is its particularity and ordinariness of the case itself that matters. It is important here to "understand what is important about the case within its own world" (Stake 2000, p. 450).

This case study was chosen because UFRGS is facing many difficulties in order to implement the transition to a sustainable educational institution. In this trajectory, the University focused in designing an institutional plan and solving problems associated with institutional strategy gaps. We rely on snowball sampling strategy in order to identify actors who should be interviewed. According to Heckathorn (1997) snowball sampling is often used because the population under investigation is 'hidden'. In the case under investigation, the strategic team involved in designing institutional plan to sustainable development was not well delimited and it wasn't possible to determine who would be interviewed in the research field before entering it. In order to do so we start with the support of a key informant—as suggested by Heckathorn (1997)—which is the project creator, the person responsible for the Environmental Advisory in the University. This actor was selected because he was the author of many proposals regarding sustainable development in the University. Afterwards, people were indicated to us because they had been involved in thinking and strategizing the University future regarding sustainable development concerns. The main focus of the interviews was to understand the challenges and obstacles associated to these activities. So, the interviewers were people involved with the strategic team involved in designing institutional plan to sustainable development, under formation. Altogether, four in-depth interviews were conducted from September, 9th to December. The respondents are:

- two members of the "Interdisciplinary Group of Environmental Management" GIGA (in Portuguese);
- an Environmental Agent;
- a person responsible for the Environmental Advisory in the University.

In order to understand the implementation process and institutional strategies we also conducted documental analysis. The documental analysis comprises reports about GIGA's formation and actions, the Environmental Agents formation and the Institutional Development Plan. These sources of information have been included in the analysis since it provides a fruitful way to understand the past processes and practices that are involved in institutional plans and strategies towards education for sustainable development.

Following research objectives and literature revision, the data collection and analysis were conducted in order to comprise the subsequent categories: (i) operations, (ii) strategy, (iii) institutional plans, (iv) actors' knowledge about institutional declaration of sustainability and future plans.

5 Activities and the Process for Achieving Sustainable Development at Federal University of Rio Grande Do Sul

In 2005, the university composed a working group for the implementation of environmental policy. In 2007, the coordinating board for environmental management was created, linked to the Dean's office. The Environmental Management System (EMS) was created in 2008 and corresponds to an interrelated set of policies, organizational practices and technical and administrative procedures. The goal is to achieve better environmental performance, control, and reduction of environmental impact, through the development and application of Action Plans structured within an Environmental Planning, using management tools (Ordinance 1461 2008).

In 2012, the Board for Environmental Management was created. Also in 2012 the Selective Collection Committee of the University is created, the objective is to implement and oversee the separation of recyclable waste discarded in the various units of the university.

6 The Challenges and Obstacles Towards Education for Sustainable Development Model

In the last decade, the difficulties and obstacles have shown that the process is delicate and slow. The University began the process of sustainable development with a group called Interdisciplinary Group of Environmental Management—GIGA (in Portuguese) in 1999, with multidisciplinary members.

The group was initially composed by teachers who practiced isolated actions at the University regarding selective collection for recycling, and other involving environmental issues. The evolution of GIGA led members to propose to the Dean a model to support environmental management, dissemination, and management in the various campuses, in 2005. Such a proposition was accepted by the Dean and one of GIGA members took the Environmental Management Coordination in 2007.

The group GIGA has been extinguished due to the overlapping of tasks with the Coordination recently established. According to interviewee A, "*GIGA was more academic with research and seminars. In the Coordination, many practical problems are solved. Regarding this focus difference between GIGA and the Coordination, the idea to form Environmental Agents came*". Anyone within the Institution could become an Environmental Agent and these people were trained

through courses provided by the Coordinator himself. According to the Manager of Environmental Advisor, this is training to some practices related to sustainable development such as: selective collection, control of electricity and water costs, accessibility, among others, are closely monitored and can be always improved.

According to an Environmental Agent interviewed, the institution had different times along the path in searching for better practices for a sustainable development. In one of the Units of the institution, she is responsible for the actions covering the issue since 2006. From 2008 on, a survey on environmental impacts of the Unit was conducted, which composed some reports. One of the most impressive environmental impacts was the decrease in the use of disposable cups. A survey on expenditure on paper has also been conducted and actions for the reduction were put into practice. The Agent also highlights the crucial importance of senior management support for their available financial resources, time, scholars, among others, if the University wants to achieve sustainable development. One challenge is continuity, since one direction can support the whole process and progress already achieved, while another may get stuck within the process, going back to the embryonic stage.

The Coordinator of Environmental Management was appointed in 2012. The manager was already responsible for the Environmental Management Coordination in the University. The work continued, although it had been physically reorganized and restructured and the staff has been changed. The Environmental Management System (EMS) implemented has references (methodology) of the *International Organization for Standardization* (ISO). The documentation, according to the adviser, is the remaining problem. Some procedures that have been performed in the institution could be registered as Normative Instructions (IN), however, they have not been performed up to now. When asked about the curriculum dissemination of any subject that deals with matters involving sustainable development in all the University majorings, the Advisor said that a draft of a project has been prepared and submitted to the Dean of Graduate Studies, but so far the possibility has not been discussed. The draft it is a link on the main page of the Institution that the students may have access to a set of content in distance education and classroom seminars, which take place continuously at the university. To obtain the certificate, the student should participate in distance learning activities besides a classroom activities in these seminars.

There are other isolated actions such as some buildings already designed respecting aspects of green building. According to the Advisor: "*All very fine. Hard to tell if it's a policy. There are initiatives in this direction, formal but not yet institutionalized*". The procedures for the formation of outsourced employees, for example, the cleaners cannot be made by the University, should be made by the contractor himself. This procedure has not been noticed in practice on a daily basis. The university presents its environmental policy for the outsourced employees. Also, there is staff turnover, which does not contribute to the initiatives that the University tries to implement.

According to the categories listed for the data analysis, we may, from data collected in interviews, assert: the commitment from the University proposal with sustainable development is weak and superficial when compared to other universities and initiatives. Despite having an Environmental Management System (EMS), activities are specific and heavily depend on directions of the Units are in accordance with the progress of practices, as the Environmental Agent says: "*In 2008 I started to have more access at all because before 2008 I had difficulty having access to information, the unit's managers did not care much about it. I had more freedom to act, to start putting into practice my knowledge of environmental management, we managed to reduce some impacts, such as disposable cup;, also we did a survey of how the Unit spent on paper, on the printouts. This was a time when the unit could realize a bit of what it was environmental management. Teachers were already beginning to get used to the environmental management and I believe they were enjoying it, because I had no complaints*".

But in 2010, when the direction of the Unit changed, the difficulties emerged again: "*the direction paid no attention to environmental management and everything is stand still up to now*".

In the assessor's interview, he pointed that: "*We also had difficulties regarding employees. Some of them were transferred to the Superintendence of Infrastructure in the last replacement of Dean. But at the same time, the exchange provides a gain, leading some members of the Environmental Advisory for the Superintendence*".

There are some isolated actions in the University. There are actions, individual transactions in certain units, conducted by environmental agents or on the initiative of teachers or employees. Such initiatives are welcome, according to the advisor. One of the initiatives proposed by an Environmental Agent is the training of people from cleaning a particular unit within the institution, however, according to the advisor: "*the University is not allowed to train outsourced staff. This prohibition prevents the University from having trained people, according to its precepts of garbage collection and other initiatives that could be developed if the staff was able to collaborate and have the necessary basic knowledge*".

In order to solve this problem, "*it is necessary contracts that are more targeted for education for sustainable development, where such prerogatives are explicit, enabling the University to charge the actions from people who provide the service in all its units*". Other isolated actions, reported in the interviews, refer to "Swap Fairs" in the Unity. Books, materials that are no longer used by people in their homes, which are offered to the academic community and the general community and are exchanged without charging.

The strategy of the University is not strongly anchored in principles that lead to sustainable development. One of the major current influences is the way the University's purchases are made; it refers to the Normative Instructions of the Ministry of Planning (Federal level). The University is already buying more durable bulbs and uses less energy, thereby contributing to the environment. There are regulations of the Ministry giving support for the purchase of environmentally friendly and efficient products, which changes the focus of previous purchases based only at the lowest price.

According to one of the members of GIGA Group, a perceptual work with higher education teachers, staff, and students was held. "*We seek to know how they perceived environmental issues within the university. The result did not surprise us too much, as we saw the most positive people were students, secondly the administrative staff. The teachers were more reactive, more negative*" (Interviewee C).

The institution develops a strategic work with all units, teachers will be the first ones affected. It is from the teachers that opportunities and ways of teaching come so that students can build a critical view of sustainable development and apply it to their workplaces and their communities and homes.

According to the Institutional Development Plan, the University aims to establish an environmental certification system, structure the environmental licensing, diagnose and monitor levels of environmental impact, rationalize the use of material consumption, and optimize the recyclable and non-recyclable waste management system. The university also intends to maintain the training program of environmental management and requires the training of contracted workers.

Teachers working for sustainable development have such a sense of responsibility for their education and their personal values. Thus, they develop something in their classes and in everyday life at the University, within their action conditions.

7 Final Discussion

This research shows the different phases experienced by the Federal University of Rio Grande do Sul regarding education for sustainable development. In order to do this, we rely on a qualitative case study, in a Brazilian Federal University that is facing obstacles regarding the transition between a traditional educational positioning to a more sustainable one. Our intention was to show the obstacles faced by the University regarding changing the educational and institutional model as well.

Our results show that the process is still emerging at UFRGS. Even though eleven years have passed, few actions were really put into practice by the educational institution. There are many reasons associated to this institutional inertia but, in this case, the biggest problem was the lack of an institutional strategy that involves the whole university, not only some undergraduate curriculums or isolated projects. The idea behind education for sustainable development is to implement an educational model that provides change in all directions: economic, political, environmental, social, cultural.

The lack of an intuitional declaration of sustainability and the actor's ignorance about future plans and directions in this sense is an evidence of an institutional strategy gap. Even though there are many actors involved, especially people that occupied strategic positions and professors directly involved with sustainability as subject, it does not lead to a real movement of change and transformation. Although it is important to highlight that any change in the process requires time and financial efforts towards the implementation. At the same time, Universities are a space of

knowledge creation and an ideal locus for transformation (Orr 1992). However, universities have either found themselves unable to implement an institutional model for sustainable development. The biggest challenge is to take away the discussions and actions about sustainability from the classrooms and put it into practice in the University itself as well.

Our intention here is to show a case study that enables us to understand the importance of strategize and think about sustainability as a collective effort and a natural condition for this kind of institution. As a case study, this work contains some limitations about the nature of research means and certain limitations in terms of generalization the results.

References

Amaral, L. P., Martins, N., & Gouveia, J. B. (2015). Quest for a sustainable university: A review. *International Journal of Sustainability in Higher Education, 16*(2), 155–172.

Cebrián, G., Grace, M., & Humphris, D. (2013). Organisational learning towards sustainability in higher education. *Sustainability Accounting, Management and Policy Journal, 4*(3), 285–306.

Chambers, D. P., & Walker, C. (2016). Sustainability as a catalyst for change in universities: New roles to meet new challenges. In *Challenges in higher education for sustainability* (pp. 1–14). Berlin: Springer International Publishing

Elkington, J. (1999). Cannibals with forks. *The triple bottom line of 21st century*. Canada: New Society

Figueredo, F. R., & Tsarenko, Y. (2013). Is "being green" a determinant of participation in university sustainability initiatives? *International Journal of Sustainability in Higher Education, 14*(3), 242–253.

Grindsted, T. S. (2011). Sustainable universities–from declarations on sustainability in higher education to national law. *Environmental economics, 2*(2)

Heckathorn, D. D. (1997). Respondent-driven sampling: a new approach to the study of hidden populations. *Social Problems, 44*(2), 174–199.

Jacobi, P. R., & Beduschi Filho, L. C. (2014) Gestão ambiental e o ensino de administração. *Janette Brunstein Arilda Schmidt Godoy Helio Cesar Silva, 121*.

Leal, Filho W. (2000). Dealing with misconceptions on the concept of sustainability. *International Journal of Sustainability in Higher Education, 1*(1), 9–19.

Leal Filho, W. (2015) Education for sustainable development in higher education: Reviewing needs. *Transformative Approaches to Sustainable Development at Universities* (pp. 3–12). Berlin: Springer.

Lidskog, R., & Elander, I. (2010). Addressing climate change democratically. Multi-level governance, transnational networks and governmental structures. *Sustainable Development, 18* (1), 32–41.

Meet New Challenges. (2016). Challenges in Higher Education for Sustainability (pp. 1–14). Berlin: Springer.

Ordinance Number 1461, April 29. (2008). *Institui o Sistema de Gestão Ambiental da UFRGS*. USA: University Archive

Orr, D. W. (1992). *Ecological literacy: Education and the transition to a postmodern world: State Univ of New York Pr*. USA: Suny Press.

Pereira, G. S. M., et al. (2014). Greening the campus of a Brazilian University: cultural challenges. *International Journal of Sustainability in Higher Education, 15*(1), 34–47.

Stake, R. E. (2000). Case studies. In Y. S. Denzin NKL, (Ed.), *Handbook of qualitative research* (pp. 1022–1040, 2nd Ed.). London: Sage Publications.

Sterling, S., Maxey, L., & Luna, H. (Eds.). (2013). *The sustainable university: Progress and prospects*. London: Earthscan/Routledge.

Wright, T. S. A. (2002). Definitions and frameworks for environmental sustainability in higher education. *International Journal of Sustainability in Higher Education, 3*(3), 203–220.

Utilising Work-Integrated Learning to Enhance Student Participation and Engagement in Sustainability Issues in Open and Distance Learning

Graeme Wilson and Rudi W. Pretorius

Abstract

Work-integrated learning (WIL) refers to a range of curricular, pedagogic and assessment practices focussed on blending formal learning with workplace concerns. In open and distance learning (ODL), incorporation of student's personal and work related experiences with sustainability concerns, presents a challenge. WIL provides opportunity for development and implementation of place-based, practical pedagogies, thereby enhancing transformation towards sustainability while adding value to ODL. This paper utilises a case study from the National Diploma in Nature Conservation offered by the University of South Africa (Unisa), a major ODL provider in the Global South. In line with the growing popularity of qualitative inquiry in educational research, the case study utilises reflective narrative inquiry to capture and analyse how the WIL component of this qualification contributes to participation and engagement of students in tasks related to communication and sustainability. Apart from blending ODL, WIL and Education for Sustainability (EfS), another unique element involves the process through which WIL is implemented in the case study. This is not based on the typical placement of students at potential employers, but involves a seven day tourist visit simulation and assessment in a local nature reserve, facilitated by Unisa. After an initial pilot run, this format of providing the Unisa nature conservation students with a WIL opportunity has since been fully implemented and is repeated annually with great success. The case study is supplemented with a qualitative assessment of the experience

G. Wilson
Department of Environmental Sciences, University of South Africa,
Private Bag X6, Florida 1710, South Africa

R.W. Pretorius (✉)
Department of Geography, University of South Africa,
Private Bag X6, Florida 1710, South Africa
e-mail: pretorw@unisa.ac.za

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_18

obtained with the inclusion of WIL in this qualification. This assessment is conducted within an empirically validated framework for evaluation of WIL curricula, thereby generating additional insight into facilitation of outcomes. The paper concludes by sharing lessons learned and issues to consider with the implementation of WIL (including synergies with EfS), as well as providing pointers for decision makers and future research and consideration.

Keywords
Environmental sustainability · Real-world learning · Work-integrated learning · Open and distance learning · Nature conservation

1 Introduction

1.1 Student Engagement and Participation as Prerequisite for Sustainability Learning

Universities are making several advances worldwide with the integration of sustainability in curricula, operations and facilities (Leal Filho et al. 2015). Despite these advances, engagement by universities with societal stakeholders in teaching and learning for transformation towards sustainability, remains a challenge and presents opportunity for further research (Trencher et al. 2015). Stakeholder engagement can provide a new dimension to the incorporation of real-world exposure in teaching and learning (Mauser et al. 2013). This can be achieved through various forms of partnerships with stakeholders across many sectors, leading to enhanced student engagement with sustainability issues and co-creation of useful knowledge (Tilbury 2011). In addition, such co-created knowledge is contextualised and supports the move away from viewing knowledge and skills acquisition as a means in itself, as called for by various scholars (Lotz-Sisitka 2012/2013). Work-integrated learning (WIL) provides such an opportunity, by requiring students to apply and learn disciplinary knowledge and skills in workplace or related contexts (Smith 2012) and forms the focus for this chapter, with specific reference to the sustainability context.

1.2 Some Realities in Terms of Real-World Learning Opportunities

In terms of competences required for enhanced sustainability, exposure of students to real-world learning opportunities and their participation therein have been shown to contribute to bridging the gap between theory and practice (Bruindiers et al. 2010). In addition, the literature on Education for Sustainability (EfS) contains

many references to and calls for pedagogical interventions aimed at real-world learning (Sipos et al. 2008). However, the reality is that students do not automatically build sustainability competences by engaging in real-world learning. In order to achieve this, the challenge is to ensure that such learning opportunities are designed collaboratively, are well coordinated, build on each other and are integrated within course structures (Brundiers et al. 2010). Since the value of real-world learning is generally acknowledged, universities are increasingly adapting their curricula to incorporate aspects as WIL, industry placement, simulations and reflective exercises to improve the graduateness of their students (Smith 2012). Up to recently, however, not much research on the effectiveness of these options has been conducted, which is an aspect in need of urgent attention (Hughes et al. 2013) and points towards the value of this chapter.

1.3 Aim, Methodology and Value of Chapter

This chapter presents a case study of utilising WIL as part of the National Diploma in Nature Conservation offered by the University of South Africa (Unisa), an institution involved with open and distance learning (ODL) in South Africa, Africa and the Global South. ODL students are typically studying while involved with work and family (Taylor 2006). As a result their participation in learning experiences that require practical type work and real-world exposure is challenging. For certain qualifications, including those related to sustainability, this limitation may constrain teaching and learning, adding to perceptions of ODL as inferior and having a single focus of knowledge transfer (Barasa 2011). This chapter showcases the value added to qualifications and sustainability learning, through blending ODL with participation in real-world learning experiences. The reflection on the utilisation of WIL in this context illustrates the innovative contribution that is provided to improve practice in terms of student participation and engagement in sustainability issues in ODL.

A structured presentation of own practice is utilised, accompanied by critical reflection on implementation. The analytic approach relies on narrative enquiry (for provision of rich descriptions of educational experiences—McNaught 2005) and reflection (a dimension of experiential learning theory—Roberts 2002). This is well-suited for the small student numbers involved in the case study (about 10) and to pick up on nuances and subtleties which would otherwise have been lost. Following the introduction, the chapter shares various perspectives on connections and trade-offs between real-world learning, WIL, ODL and EFS. The rest of the chapter deals with the case study on WIL at Unisa and a critical assessment of the implementation experience. The latter is conducted within the evaluation framework of Smith (2012) for WIL curricula and is supplemented with a snapshot of typical feedback obtained during the WIL experience. The conclusion highlights the value of WIL in EFS and ODL, challenges experienced during implementation, lessons learnt and future perspectives.

2 Perspectives on Contextualised, Real-World Learning for EfS

2.1 Competences Required for Sustainability

Described as the ability to be able to do something (Mochizuki and Fadeeva 2010), competences acquire a special meaning in the context of EfS, and can be regarded as a methodology for embedding the transformation towards sustainability in learning and curricula (Wals 2014). A narrow view of competences in terms of workplace performance is clearly not at stake, but emphasis on the development of agency and being a qualified, able and willing participant (Jensen and Schnack 1997). With reference to sustainability, this implies competences to utilise relevant knowledge in a moral way, to distinguish between and value different types of knowledge, to view the issue/s at stake holistically, to recognise the value of inter-disciplinary collaborations and to contribute to such endeavours, and to acquire a meta-perspective, serving as enabler to participate in the knowledge society (Parker 2010). These requirements for competences indicate the need for moving away from "Business as usual" with reliance on disciplinary learning, towards approaches aligned to "action competence" (Mogensen and Schnack 2010). In this context "action" and "competence" are qualified in terms of not only the intentions of the agent, but also as being purposeful and conscious.

2.2 Value Added Through Work-Integrated Learning (WIL)

Although WIL can take many different forms, all are geared towards providing students with opportunities to apply their knowledge and skills in real-world workplace contexts. WIL covers a wide range of possibilities (Jackson 2015), varying from the typical placement of students in industry and internships to possibilities offered by service learning, whereby students participate in service activities of benefit to communities in an organised way. Partnerships between higher education institutions and industry therefore provide further opportunities for the contextualisation of learning, bridging the theory-practice gap and building graduateness (Venables and Tan 2009). It is generally accepted that WIL contributes significantly to the job-readiness of students through building a range of employability skills, including the ability to work in teams, contribute to problem-solving, communicate effectively, use information technology and act professionally (Freudenburg et al. 2011). However, implementation of WIL in higher education institutions remains a challenge (Coll and Zegwaard 2006), with the understanding of best practice in assessment and how outcomes are facilitated by curricula, not yet fully established (Smith 2012).

2.3 Experience with WIL and EfS in the Higher Education Context

When considering the essence of EfS, articulated by Bruindiers et al. (2010) as a set of core competences consisting of strategic, practical and collaborative knowledge, the linkages between EfS and WIL are evident. The type of knowledge implied here refers to procedural knowledge (Redman and Redman 2014), which goes beyond asking "What?", to the level of asking "Why?" and "How?". Taking a sustainability focus in course-work and assessment in WIL therefore seems advantageous—the implication being that students have to deal with real-world issues in a way extending beyond vocational issues. With a focus only on the latter, students would be inadequately equipped to deal with the requirements of sustainability (Jennings et al. 2015). This signifies a move from Mode 1 to Mode 2 knowledge production (Gibbons et al. 1994), with the emphasis shifting to relevance of research for industry, collaborations between industry and universities and commercialization of university research (Albert and McGuire 2014). The connection between WIL and EfS thus not only supports graduateness of students in terms of work-readiness, but is equally beneficial to enhance competence "about" as well as "for" sustainability (Sipos et al. 2008).

3 Case Study: WIL as Part of the National Diploma in Nature Conservation Offered by Unisa

3.1 Contextual Setting: Unisa and ODL

The case study on WIL presented here, is associated with the National Diploma in Nature Conservation (NDNTR), offered by the Department of Environmental Sciences in the College of Agriculture and Environmental Science at Unisa. With more than 400,000 students and qualifications from certificates to degrees, Unisa is in the league of the world's mega ODL institutions (Unisa 2016). Given its experience, capacity and reach, and with the vision "*The* African University shaping futures in the service of humanity" (Unisa 2015), Unisa is well positioned to play a role in EfS. This links with Unisa's 2030 strategy (Unisa 2015), with focus on the need for contextually relevant programmes responsive to current and future societal needs. With greater emphasis on pedagogies for active and collaborative learning, linked with a roll-out of e-learning (Unisa 2015), Unisa has succeeded to largely shed the classic image of "distance education" as relying only on transmissive pedagogies.

3.2 Study Programme: Background, Structure and Aim

The NDNTR offered by Unisa constitutes a three-year qualification of 360 credits at Level 6 of the National Qualifications Framework of South Africa (B-degrees are typically pitched at Level 7). This qualification aims to deliver competent graduates to the conservation industry who will be able to function in a supporting role to conservators and resource managers and/or participate in functions related to the management of natural resource areas. The curriculum comprises of a theoretical, practical and WIL component. The theoretical component is offered primarily through blended and e-learning whilst the practical component requires attendance of contact sessions. The WIL component requires exposure to and participation in real-world learning experiences in the natural environment. A total of 120 credits of the NDNTR are devoted to WIL, requiring of each student to develop and acquire relevant workplace-based skills and experiences.

3.3 Format of WIL for the NDNTR

Students registered for the WIL component have to attain on average 60 days of working experience across seven categories (Animals, Plants, Technical, Communications, Legal and Security, Resource Management, Administration). They are required to log a range of experiences and skills under each of these categories. Through this students are expected to gain a contextual understanding of conservation concepts and their application through a diversity of work-related experiences. To achieve this, students have to secure suitable placement together with industry employed mentors. For many students this is a major challenge, with the ODL context implying that the geographical location of students often does not match the location where WIL opportunities are provided. This is in agreement with Kamper and du Plessis (2014), reporting similar challenges associated with WIL for education students. The summative assessment of WIL for the NDNTR comprises five reports in scientific format, a logbook and a portfolio of evidence, with a defence during an interview. The diversity of placement contexts, mentorship styles and focus, presents a challenge concerning fairness, consistency and quality in assessment.

3.4 Partnership with Telperion Nature Reserve

In an attempt to address the scarcity of placement opportunities and to homogenise learning, assessment and mentoring, a three-way stakeholder partnership was signed in 2007, which saw a non-governmental organisation (NGO) plan and host undergraduate Unisa Nature Conservation Student excursions to the Ernest Oppenheimer and Son (EOS) owned Telperion Nature Reserve (Wilson and Wilson 2015). The agreement was founded on a mutual desire to see that students complete their academic requirements, graduate and take up positions in the conservation

sector. Following the withdrawal of the NGO from the partnership after four years, a new agreement was reached in 2012, allowing continuation of conservation skills development and training on Telperion, but with Unisa since then in the role of simulating an experiential learning provider. EOS provides annual financial support for the programme to ensure that students are able to travel to and from, stay, work and learn while participating in the WIL excursions offered at Telperion. Unisa ensures that the additional resources are provided to guarantee that all mentorship and skills development activities at Telperion take place for the benefit of all stakeholders.

3.5 More on Telperion Nature Reserve, the Programme and the Activities

Telperion is situated on the western boundary of the Mpumalanga Province of South Africa, approximately 90 km east of the capital, Pretoria. The reserve falls within a poorly conserved vegetation type and is subject to alien plant encroachment and soil erosion. Although historically used for agriculture and stock farming, current land use is focused on biodiversity conservation, with related educational and research activities. The Unisa-Telperion partnership programme comprises of a formal excursion each month of the year, excluding the examination period of October and November. Excursions are five to seven days long and focus on the outcomes assigned to one of the WIL categories. The aim is to immerse students into an authentic environment, where they work alongside management and staff. Students are assigned conservation work to complete and are expected to apply their collective understanding to cooperatively address related tasks. Throughout the excursion, the students are mentored and guided by an academic with conservation experience. Data and evidence gathered during the excursion is used by the students to draft and submit a formal report, which is used for assessment.

3.6 Example: Seven Day Tourist Visit Simulation and Assessment

A communication-focused WIL excursion was piloted at Telperion in 2012 (Wilson et al. 2013), simulating a tourism experience with game drives and interpretative walks, and was since offered again in 2015. These excursions were facilitated to meet the requirements of the "Communications" WIL category of the NDNTR, in the absence of a participating WIL sector service provider. A major outcome associated with this excursion was to ensure that students gain relevant experience in dealing and communicating with people of all ages, genders, races, religions and cultures. They needed to use the time spent at Telperion to improve their individual and collective communication skills in, about and for the environment and biodiversity conservation.

The outcomes of this excursion focussed on the experience and skills gained by students and required formal assessment. Two components can be distinguished, namely continuous assessment (by the WIL mentors) and summative evaluation, replacing the usual submission of formal reports post excursion. During the first five days students had to familiarise themselves with communication theory and prepare the various activities to be formally presented to the visiting tourists. Students were required to form pairs and share responsibilities. The planned activities were critiqued by the entire group through collaborative learning. The 'tourists' for which the simulated programme was set up, were actually Unisa academics, playing the role of tourists, but who would also be involved in the assessment.

The last two days of the excursion focused on the implementation of the programme, as developed and planned by the students. The NDNTR WIL students conducted a meet and greet, a formal presentation, game drives, interpretive walks and a static display. The WIL mentors accompanied the 'tourists' and the students on all their activities and assessed the students based on a number of mutually agreed assessment criteria. The 'tourists' had to provide formal feedback on the various activities. These and the individual assessments formed the student's WIL Communications mark. Each student was allocated specific individual activities to conduct as part their assessment.

3.7 Reflection on the Simulated Tourist Visit

From the mentor's viewpoint, excursion objectives were achieved by assessing students on-site while presenting on their allocated themes. Written assessments would not have captured their competence in the same way, while the synchronous interaction with the 'tourist' (academics) provided students with the opportunity to gain prompt feedback on their efforts. Students regarded the interaction with these academics as a highlight of the simulation. They furthermore expressed appreciation for the opportunity to provide direction for the programme. This component of the excursion saw the students bond together and work as a team. The academics indicated that the opportunity to interact with the students was refreshing and that they would have enjoyed even more interaction with them. They were impressed with the students' enthusiasm and confidence and the way in which they applied knowledge. Overall it was shown that simulations of some WIL outcomes are a workable alternative to formal placement. Consistency and greater quality assurance is guaranteed as the mentors (who are employed as academics by Unisa) have a clear understanding of the requirements of the WIL curriculum.

4 Critical Assessment: Role of WIL in the Unisa Example (Tourist Visit Simulation)

Although the consensus opinion from the literature points towards the advantages associated with WIL, some gaps remain in research towards a better understanding of how these types of programs achieve outcomes pointing towards the increased capabilities of graduates (Hu et al. 2009). In addition, attempts to conduct assessments of WIL with quantitative instruments seem to be less successful (Smith 2012), since these instruments do not capture all essential WIL elements adequately. The framework developed by Smith (2012) attempts to address these shortfalls. This framework is based on six empirically validated constructs and allows assessment of both the curriculum components and outcomes of WIL programmes. In this way a deeper understanding of both these aspects of WIL can be achieved. Due to the relative small number of students involved in the tourist visit simulation (typically not more than ten at a time), this assessment relies on a qualitative rather than quantitative approach. The reflective narrative shared here is based on observations by the mentor (one of the authors), and supplemented with a snapshot of the type of feedback that has been obtained, as reported from the vantage point of the mentor.

- *Authenticity.* This is a core aspect of WIL, with most WIL-curricula claiming to provide students with a real work environment. Students encountered realistic problems throughout the 'tourist' simulation, with the visiting academics expressing their satisfaction with the level of confidence and knowledge of students whilst engaging with applications in real-world situations. Problems which the students encountered required intense and sustained engagement from each of them to ensure that they all achieved the set aims. Although guidance is initially supplied by the mentor, autonomous planning and implementation are required as part of WIL experience.
- *Alignment of teaching and learning activities with integrative learning objectives*. The emphasis of this construct is that some integration between theory and practice constitutes the core intellectual activity for students (Dymock and Gerber 2002). This was a weakness of the 'tourist' simulation, although the mentor was available during planning and highlighted pertinent theoretical information. In line with this shortfall, one of the visiting academics suggested a change to the format of the excursion to provide students with more engagement opportunity on matters concerning science and reserve management, which links directly with reflective learning objectives.
- *Alignment of assessment with integrative learning objectives.* To achieve the objective of integrative learning presents a challenge, and it therefore has to be deliberately designed into assessments (Svensson et al. 2004). In the case of the 'tourist' simulation this was achieved through setting time aside during which each of the activities and participating students were assessed in terms of the set learning outcomes. The participating students responded positively regarding

this construct, with comments typically alluding to the readiness of students to work together and the fact that students were able to respond professionally to most of the questions that they were asked.

- *Integrated learning support*. The importance of supplying support to students during WIL is highlighted by several authors, including Keogh et al. (2007), with a clear need to measure and evaluate the nature of such support. While no formal materials were supplied to support the students during the 'tourist' simulation, this gap was addressed by encouraging them to find the required support or information from the Internet. The type of feedback obtained from students that participated in the excursion similarly indicates that they had sufficient information to perform the required tasks and that they were of the opinion that they were adequately prepared in this regard.
- *Supervisor access*. This relates to the contact between the mentor and students during the WIL experience. The purpose is to provide feedback on learning and support while the experience is taking place. This appeared to have worked very well during the 'tourist' simulation, with a 'soft touch' approach interspersed with a few formal sessions, thus providing an opportunity for students to 'check in' with their mentor, to present their progress and to obtain feedback. Both the visiting academics and participating students provided positive feedback in terms of this construct, indicating that they appreciated the opportunity to get to know and to learn from each other.
- *Induction and preparation process.* The administrative load to prepare students for WIL is acknowledged to create a burden on the academics involved. In terms of the 'tourist' simulation, participating students were selected from a larger cohort of potential students, and this selection had to be facilitated by the mentors. Since only more experienced students were selected, more time was available to focus on the desired simulation outcomes. Although a time consuming activity, the investment in terms of the preparation for the simulation paid off well, resulting in feedback typically expressing satisfaction with the preparation, planning and the simulation overall.

5 Conclusion

5.1 Lessons Learnt Through the Unisa-Telperion Partnership

Consideration of the 'tourist' simulation as part of the NDNTR offered by Unisa, clearly shows how WIL partnerships with industry can contribute to the academic and experiential learning of students. By providing 'in-house' mentors with a deep understanding of the curriculum and its implications, Unisa was able to provide all the guidance and support students needed to succeed in the 'tourist' simulation. In addition, the evidence presented points towards students taking ownership of their learning environment and outcomes and being more confident of their achievements

while working co-operatively. The freedom or openness of the programme enabled them to chart their own progress and manage their own outputs, while knowing that their mentors were observing them and were close at hand to assist when required. Unisa succeeded in improving the throughput rate of these students by providing on-site mentorship, through which it was also possible to overcome the challenges associated with placement.

5.2 Potential of WIL to Enhance Student Participation and Engagement

Whether some of the outcomes of the 'tourist' simulation were left to students to determine, or whether the simulated programme was designed by the students themselves, the result points towards more motivation for them to participate out of their own free will and not in response to academic 'carrots' and 'sticks'. In this way a partnership was created between the students and academic mentors, working together to achieve programme outcomes. Clear roles and responsibilities ensured that participation, interaction and engagement were all within the confines of achieving the aims and objectives. An advantage observed was that students are better motivated simply because the benefits associated by fully participating and committing, are immediately experienced. Further improvement could follow from better integration of WIL outcomes with assessment, so that it can be achieved synchronously and on-site. In addition, fewer WIL activities but with higher academic mentorship involvement can be considered.

5.3 Synergies Between WIL and EfS—The Way to Go?

This reflection on WIL, as featuring in the NDNTR offered by Unisa, illustrates the existence of a mutually beneficial relationship between WIL and EfS. Seen from one perspective, a sustainability focus assists in transforming WIL beyond a focus on vocational issues only and adds a new dimension to real-world learning. From a different perspective, EfS, with its required emphasis on interaction, reflexivity and to look at theory and practice in an integrated way, can benefit significantly from the opportunities provided through WIL for immersing students in meaningful real-world experiences. From all perspectives, ODL students gain significantly from incorporation of WIL in curricula, which upgrades their learning experience from theoretical only, to a level exposing them to direct engagement with sustainability issues. Although this acts to constrain participation in ODL, the advantages in terms of graduateness and employability are important considerations to incorporate WIL and/or aspects EfS in curricula.

Acknowledgments The authors would like to thank the participants in the 2012 and 2015 WIL excursions to Telperion Nature Reserve for their feedback and cooperation.

References

Albert, M., & McGuire, W. (2014). Understanding change in academic knowledge production in a Neoliberal era. In S. Frickel, D. J. Hess (Eds.), *Fields of knowledge: Science, politics and publics in the neoliberal age (Political power and social theory)* (Vol. 27, pp. 33–57). UK: Emerald Group Publishing. (p. 312).

Barasa, F. S. (2011). Promoting open and distance learning in Africa: A critical reflection on rhetoric, real and ideal. *Paper presented at the Conference of Rectors, Vice-Chancellors and Presidents of African Universities*, May–June, 2011, Stellenbosch, South Africa

Brundiers, K., Wiek, A., & Redman, C. (2010). Real-world learning opportunities in sustainability: From classroom into the real world. *International Journal of Sustainability in Higher Education, 11*(4), 308–324.

Coll, R., & Zegwaard, K. (2006). Perceptions of desirable graduate competencies for science and technology new graduates. *Research in Science and Technological Education, 24*(1), 29–58.

Dymock, D., & Gerber, R. (2002). Unintegrated training? Exploring links between off—and on-the-job learning. *Education and Training, 44*(1), 23–30.

Freudenberg, B., Brimble, M., & Cameron, C. (2011). WIL and generic skill development: The development of business students' generic skills through work-integrated learning. *Asia-Pacific Journal of Cooperative Education, 12*(2), 79–93.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P., & Trow, M. (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies* (p. 192). Sage, Thousand Oaks: CA.

Hu, X., Abadeer, O., Husman, C. (2009). Evaluation of engineering work experience programs (I): Principles. *Proceedings of the 20th Annual Conference for the Australasian Association for Engineering Education, 6–9 December 2009: Engineering the Curriculum* (p. 918). Engineers Australia. http://search.informit.com.au/documentSummary;dn=919582639274035;res=IELENG. Last accessed April 23, 2016.

Hughes, K., Mylonas, A., & Benckendorff, P. (2013). Students' reflections on industry placement: Comparing four undergraduate work-integrated learning streams. *Asia-Pacific Journal of Cooperative Education, 14*(4), 265–279.

Jackson, D. (2015). Employability skill development in work-integrated learning: Barriers and best practice. *Studies in Higher Education, 40*(2), 350–367.

Jennings, G., Cater, C. I., Hales, R., Kensbock, S., & Hornby, G. (2015). Partnering for real world learning, sustainability, tourism education. *Quality Assurance in Education, 23*(4), 378–394.

Jensen, B. B., & Schnack, K. (1997). The action competence approach in environmental education. *Environmental Education Research, 3*(2), 163–178.

Kamper, G. D., & du Plessis, E. C. (2014). Some critical reflections on open distance learning, with particular reference to work-integrated learning. *Africa Education Review, 11*(1), 77–90.

Keogh, K., Sterling, L., & Venables, A. (2007). A scalable and portable structure for conducting successful year-long undergraduate software team projects. *Journal of Information Technology Education, 6*, 516–540.

Leal Filho, W., Brandli, L., Kuznetsova, O., & Paco, A. (Eds.). (2015). *Integrative approaches to sustainable development at university level. World Sustainability Series* (p. 731). Switzerland: Springer.

Lotz-Sisitka, H. (2012/2013). National case study–Teacher professional development with an education for sustainable development focus in South Africa: Development of a network, curriculum framework and resources for teacher education. *Southern African Journal of Environmental Education, 28*, 31–71

Mauser, W., Klepper, G., Rice, M., Schmalzbauer, B. S., Hackmann, H., Leemans, R., et al. (2013). Transdisciplinary global change research: the co-creation of knowledge for sustainability. *Current Opinion in Environmental Sustainability, 5*, 420–431.

McNaught, C. (2005). Understanding the contexts in which we work. *Open Learning, 20*(3), 205–209.

Mochizuki, Y., & Fadeeva, Z. (2010). Competences for sustainable development and sustainability: Significance and challenges for EFS. *International Journal of Sustainability in Higher Education, 11*(4), 381–403.

Mogensen, F., & Schnack, K. (2010). The action competence approach and the 'new' discourses of education for sustainable development, competence and quality criteria. *Environmental Education Research, 16*(1), 59–74.

Parker, J. (2010). Competencies for interdisciplinarity in higher education. *International Journal of Sustainability in Higher Education, 11*(4), 325–338.

Redman, E., & Redman, A. (2014). Transforming sustainable food and waste behaviors by realigning domains of knowledge in our education system. *Journal of Cleaner Production, 64*, 147–157.

Robberts, B. (2002). Interaction, reflection and learning at a distance. *Open Learning, 17*(1), 39–55.

Sipos, Y., Battisti, B., & Grimm, K. (2008). Achieving transformative sustainability learning: Engaging head, hands and heart. *International Journal of Sustainability in Higher Education, 9* (1), 68–86.

Smith, C. (2012). Evaluating the quality of work-integrated learning curricula: a comprehensive framework. *Higher Education Research and Development, 31*(2), 247–262.

Svensson, L., Ellström, P.-E., & Åberg, C. (2004). Integrating formal and informal learning at work. *Journal of Workplace Learning, 16*(8), 479–491.

Taylor, D. (2006) Issues, trends and challenges in distance education: An international perspective. http://ejournal.narotama.ac.id/files/Issues,%20Trends,%20and%20Challenges%20in%20Distance%20Education%20%20An%20International%20Perspective.pdf. Last Accessed January 24, 2016.

Tilbury, D. (2011) Education for sustainable development: An expert review of processes and learning (p 132). Paris: UNESCO. http://unEfSoc.unesco.org/images/0019/001914/191442e.pdf. Last Accessed January 24, 2016.

Trencher, G., Terada, T., & Yarime, M. (2015). Student participation in the co-creation of knowledge and social experiments for advancing sustainability: experiences from the University of Tokyo. *Current Opinion in Environmental Sustainability, 16*, 56–63.

Unisa. (2015). *Unisa strategic plan: 2016–2030*. Pretoria: Unisa

Unisa. (2016). *About. The leading ODL university*. Pretoria: Unisa. http://www.unisa.ac.za/default.asp?Cmd=ViewContent&ContentID=17765. Last Accessed February 7, 2016.

Venables, A., & Tan, G. (2009). Realizing learning in the workplace in an undergraduate IT Program. *Journal of Information Technology Education, 8*, 17–26.

Wals, A. (2014). Sustainability in higher education in the context of the UN DESD: A review of learning and institutionalization processes. *Journal of Cleaner Production, 62*, 1–138.

Wilson, G. A., Wilson, A. (2015). The Telperion Unisa Conservation Mentoriship Projet, a growing success story, n.p. *Diamond Route Research Conference.* www.diamondroute.com/research-database.htm. Last Accessed February 12, 2016.

Wilson, G. A., Wilson, A., Groenewald, T. (2013). The success of communications based, nature conservation, work-integrated learning simulation through a Unisa and Ernest Oppenheimer & Son Partnership on Telperion Nature Reserve, n.p. *Diamond Route Research Conference.* www.diamondroute.com/research-database.htm. Last Accessed February 12, 2016.

Campuses as Sustainable Urban Engines—A Morphological Approach to Campus Social Sustainability

Luísa Cannas da Silva and Teresa Valsassina Heitor

Abstract

This paper focuses on university campuses and precincts, and their roles within urban context. It explores the role campus morphology plays in the local impact of the institution, fostering its ability to engage in successful urban dynamics, as well as acting as an urban engine. The aim is to provide a methodological description of its elements and their morphological traits with an effect on campus integration within its adjacent environments. It is argued that one of the major aspects of sustainable development in universities relies on the relationships established between university and its environs, since universities perform a key role in urban dynamics in the current context of knowledge based societies and economies. Their impact exceeds the physical connection and their environmental footprint, as universities largely contribute to bringing dynamism to cities, through their mission, actors, activities and flows of movement. Thus, campus social sustainability relies on the relationships established between university and its environs.

Keywords

Campus · Urban morphology · Synergy · Sustainable urban development · University morphology

L. Cannas da Silva (✉) · T.V. Heitor
CERIS—Civil Engineering Research for Innovation and Sustainability, Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal
e-mail: luisacanasdasilva@tecnico.ulisboa.pt

T.V. Heitor
e-mail: teresa.heitor@tecnico.ulisboa.pt

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_19

1 Introduction

Universities worldwide face nowadays a context of fast-paced change. Societal modifications, i.e., political and social changes, as well as technological innovations impacting learning activities, are strongly affecting higher education globally. Despite the fact that emphasis is set on technology, and investments have been made in state-of-the-art equipment and facilities in universities all over the globe (den Heijer 2011), the physical space still acts as a facilitator for all learning activities, promoting and encouraging innovative learning strategies and human interactions (Bacharel Carreira 2015).

This paper focuses on the connections between university and city, as ties that can promote a sustainable urban and social development, as well as provide spaces that can enable learning activities. It assumes these connections may establish the conditions for innovation and knowledge development (Williams et al. 2008). Thus, sustainability is perceived in a broad, socially focused, context, assuming that the university built environment—university morphology—can actively contribute to develop strong social sustainability for its contribution to promote long-term connections and deep community engagement.

It is argued that, even in a progressively more globalized world, knowledge diffusion processes (and therefore, higher education) are context-sensitive (Heitor 2012) and therefore, the physical space must adjust to meet these specificities and include them in its conception.

Furthermore, "education is a spatial act" (Campos Calvo-Sotelo 2009) with all the constraints and possibilities that it brings about, and despite the diversity in typologies and morphologies, the university campus is an entity of growing importance in western societies. Whereas learning environments and learning spaces have been on the center of research for several years now, the studies on campus morphology still have a long path to undertake, in order to provide general and relevant conclusions towards its design and development strategies. Nonetheless, it is interesting to realize that some of the concepts on the basis of Jefferson's academical village, applied in the conception of the University of Virginia, in 1817 (Turner 1984)—such as the importance of interaction and communication—are being more and more valued nowadays (Barnett and Temple 2006; Temple and Barnett 2006; Mitchell 2007; Wiewel and Perry 2008; Caldenby 2009; Gensler 2012; Bacharel Carreira 2015) and changing the way we perceive higher education.

On global knowledge based society, it is critical to analyze the impact and the role the physical space must perform, in order to foster processes of social, economic, and environmental integration and, therefore, enable sustainable urban development. As the university re-affirms its statute of main knowledge producer and provider, it cannot be dismissed that technological development is in part dependent on the social context where it is embedded (Heitor 2012), which affirms the importance of the physical presence of the university. Besides, the university as a physical urban entity, comprises also a teaching mission for it conveys information, knowledge, and an image of higher education, as it successfully participates

in its context. Universities' contribution can go as far as the improvement of decaying and aging cities (Filion et al. 2004). The decline of urban dynamism and vitality, caused by the recession of the economy and the inverted demographic structure, among other factors can severely damage contemporary societal models. Evidence shows that universities can play a key role in this process, contributing to its upturn and proposing solutions (Adhya 2010), and contributing through their physical space to bring dynamism to their surroundings, enabling "social sustainability through their built environment" (Heitor 2000) to contemporary cities.

This paper is organized in three parts: the first one justifies the pertinence of the social integration of campus, in the current knowledge and learning societies context (Lundvall 2004, 2009). The second is focused on specific morphological features that are perceived as enablers or disablers for activity generation, including campus boundary conditions and integration within urban tissues. The aim is to identify and classify morphological homogeneous categories and determine the level of integration of campus built fabric. The third part provides some clarification on the morphological traits that affect the ability of the university to establish itself locally as an urban engine and a synergy enabler.

2 Universities and Their Local Impact

The present change in perspective towards science, knowledge, and the University, breaking the barriers between academia and society, may have substantial impact on the built environment, since the wider community may have access and recur to university facilities for a wide range of activities.

The physical setting of a university can be regarded as both a dependent and an independent variable (Holanda 2010). As a dependent variable, it is determined by both the socio-cultural milieu and the urban environment in which it comes about: the institution itself, the community that engages in it, the city where it is located, its morphology, land use patterns and dynamics. The university mission, its identity, and its focus will influence the physical space. These elements will affect university scale, its openness towards the community, generating a bi-lateral influential development of university premises. In addition to being the scenario that makes all the activity possible, the physical space is the vehicle through which the university expresses its culture and values (see Fig. 1). In doing so, at the same time, the physical space acts as an independent variable. It will affect the way university community engage in the learning process, the way the university is perceived by society, as well as the level of civic engagement of the university.

The role of University facilities in urban dynamics has progressively become more complex, affecting directly all users (academia and non-academia), and reaching all spheres of society. Merely their physical presence is already an element of change. University activities impact in many ways their vicinity and wider communities to the mutual benefit of both (Knight 1995; den Heijer 2011), interfering in the process of urban development, in parameters such as employment,

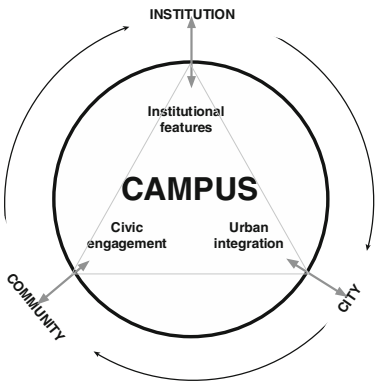


Fig. 1 Campus as both dependent and independent variable in the relationship with its community

housing, mobility, leisure and consumer activities (Indovina 1997). As central elements in a knowledge economy, universities can contribute to urban regeneration, not only directly by improving the built environment quality, but also reclaiming city areas and funds from public regional players. Today's idea of university shows an entrepreneurial entity, able to actively contribute for the social fabric and engaging in social, economical and cultural challenges (Corneil and Parsons 2007), assuming the importance of the third strand of its mission—that of civic engagement (Building Futures 2009; Witty 2013).

University engagement in successful urban dynamics, including its topological and functional integration, can be a key factor for attaining a sustainable urban environment. In fact, in the current context, where knowledge-based activities are seen as key drivers for economic growth, university impact within societies has achieved levels never observed before.

Also, research suggests the strongest potential of urban areas to attract knowledge workers (Van Winden 2010). It is crucial that urban territories rise to the expectations of the knowledge workers, merging four different structures: university, research and innovation, economy, and territory (Fouchier 2012). Thus, the surrounding environment can also be a key factor in the success of an academic institution, for the ability it has to attract and retain knowledge workers. This dual relationship highlights the importance of dialogue between knowledge institutions and cities, on an attempt to allow an interconnected growth and development, since institutions and their hosting cities tend to become more and more co-dependent.

3 Methodology

This analysis was based on the evaluation of 50 case studies, located worldwide. Emphasis was set on European and American institutions, for the strong impact and influence they exert on their peers from other regions. These case studies were chosen taking into account university values, such as its mission, and impact, both

locally and internationally, as well as types of construction, pedagogical strategies, political, and urban contexts. Their foundation dates range from the 11th to the 20th centuries, covering a great variety typologies and architectural and urban models. They were analyzed regarding their morphological features, particularly the ones that would affect the urban surroundings of the university and its ability to promote synergies.

University morphology is approached through the relation established between university and city. This relation can be either supported by the precinct or the hosting city in different levels of dependency and connections towards one another.

The term precinct is used to generally refer all types of university physical structures, with different scales and different morphological traits. Still, for the importance of the term "campus", its worldwide use and impact, and the significance it carries, it is also used, even though its meaning in this context is the same as precinct, and it does not refer exclusively to campuses in a strict term, intrinsically connected with American higher education model (Turner 1984).

This evaluation allowed to develop the following typologies, and to categorize universities according to them. It includes also an assessment of university location in an attempt to correlate its topological integration with its morphological features.

The first demarcation was established according to the level of dependence from the university towards the city. It allowed to distinguish cases where the precinct behaves as an autonomous entity from the ones in which the university is strongly connected to its urban environment.

This demarcation allows for further morphological categorization. The presented categories and sub-categories were defined through a wide-range sample of case studies, analyzed in order to obtain wide-reaching data on the morphological traits of universities.

4 Analysis and Results

The first typology considers the precinct as an (almost) autonomous entity—*campus as a city*. The main functions required for a university to function and support the continuous presence of people, are supplied by the precinct itself: it hosts not only the learning, researching and some leisure activities, but also all the functions that support the living activities of its population (for instance, residences or halls, canteens, medical services, and so forth). These precincts attempt to shield their users from exterior disturbances and activities. Nevertheless, in most cases, they also welcome outside users. They are mostly located in the outskirts or even outside the urban region, but they can also be established within the tissue of the hosting city. Still, they have the ability to establish themselves as independent entities, which could function almost autonomously.

The second case considers the precinct as being deeply anchored in an urban structure—*city as a campus*—therefore not needing to fulfill all of the needs associated with the continuous presence of people. It establishes itself in relation to

the city. It hosts mainly learning and research related functions, albeit in some cases including leisure facilities also. This kind of university structure deeply depends and relies on the city infrastructure, not being able to function autonomously.

These typologies were subdivided in 4 sub-categories. Each one presents different morphological features, impacting their perceived integration levels. These features also influence the users' perceptions and appropriation of the space. Globally, they alter the way the university performs towards its environment, therefore impacting its ability to establish synergies and connections on a close range scale.

The first one—university precinct as an autonomous entity—includes: (a) autonomous precinct; (b) attached precinct; (c) inner precinct; and (d) developer precinct. The second one—university as a rooted entity in the urban fabric—comprises: (e) self-enclosed precinct; (f) open precinct; (g) scattered precinct; and (h) ubiquitous precinct.

The following Table 1 presents the sub-categories, according to their interdependency towards the city and their integration in the urban fabric.

Pictures 2–41 exemplify some of the variables analyzed, for each typology.

Table 1 University morphological typologies

Interdependency with the city	− −	−	+	++
University as an autonomous entity	Autonomous precinct "Campus without the city"	Attached precinct "Campus edging the city"	Inner precinct "Campus in the city"	Developer precinct "Campus as the city"
University as a rooted entity	Self-enclosed precinct "City around the campus"	Open precinct "City in the campus"	Scattered precinct "City as the campus"	Ubiquitous precinct "City is the campus/Campus is the city"
Integration in the urban fabric	− −	−	+	++

4.1 University as an Autonomous Entity

(a) Autonomous precinct—*"Campus without the city"*

This scenario comprises university precincts that establish minimum ties with the closest city. It is sustained that each university depends at a certain level from an urban area. However, in the case of the autonomous precinct, its secluded location already disrupts most of the immediate connections. In this case, morphological links are very limited, and it is argued that any relationships established do not depend or require specific morphological aspects.

Precincts belonging to this sub-category need to host all activities consentaneous with the permanent presence of people. Thus, all living functions are hosted in-campus, granting that all users (students, teachers, academics and staff) do not need to commute or to exit the precinct on a daily basis. Besides all the basic functions, leisure facilities and activities are also provided.

Usually these precincts are compact (they tend not to be dispersed in the territory, but mostly concentrated in a single location) and have low construction density, as permitted by their secluded location.

Their frontiers are mostly visible and clearly perceptible, recurring to natural elements and permeable boundaries. The secludedness of the location usually grants the isolation character some universities desire, therefore there is no pressing need for walls or other segregation physical elements. Accessibility is usually low, still most cases are accessible through public transportation means. They are not perceived as inviting structures, and most of their users are university affiliated.

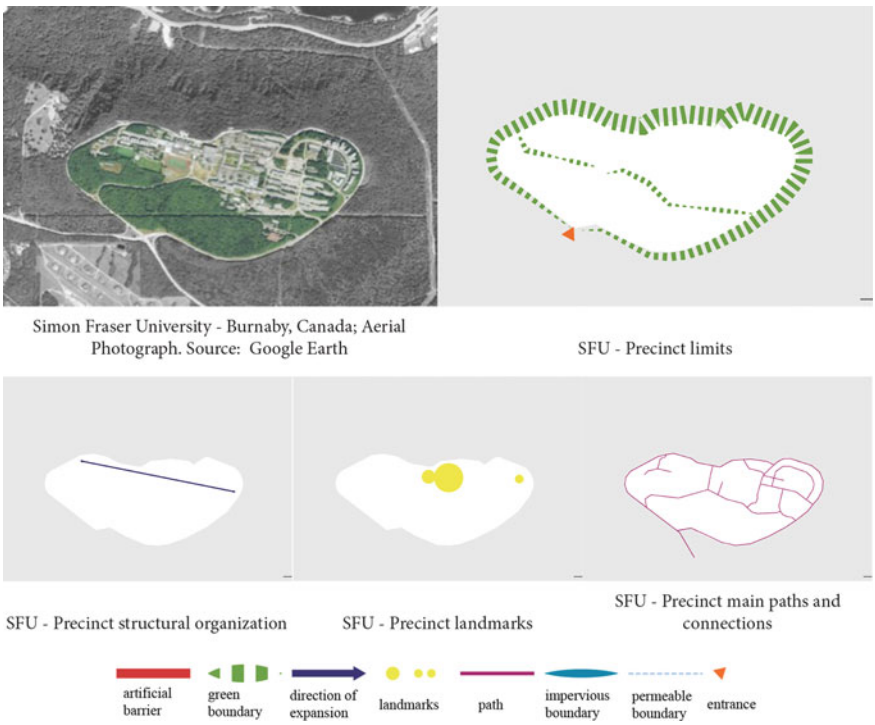
Autonomous precincts tend to be uni- or bi-directional, concentrating its main landmarks in the central area and in places not visible from the exterior (Figs. 2 to 6).

(b) Attached precinct—*"Campus edging the city"*

In this sub-category, the precinct still maintains its self-sufficiency as in the previously described. Yet, it is located in the edge of an important city, establishing a physical connection between the two entities. In this case, the precinct seeks some degree of secludedness, being located in a peripheral location, but either the city grew and a proximity relation was intensified, or it was already located in an edge, in order to get, not only secludedness, but also the right degree of proximity to permit the establishment of some connections.

These precincts usually host most activities that allow for the permanent presence of people. All living functions are hosted in the precinct, granting its independence towards the city. Besides all the basic functions, leisure facilities and activities are also provided. Nonetheless, not all users chose or are demanded to live in campus, and most of them opt by living in the adjacent city.

These precincts became common in the post-war European context, in which universities faced a high-paced increase in enrolling numbers and had to fight lack of space and facilities. This combined with the need for more specific

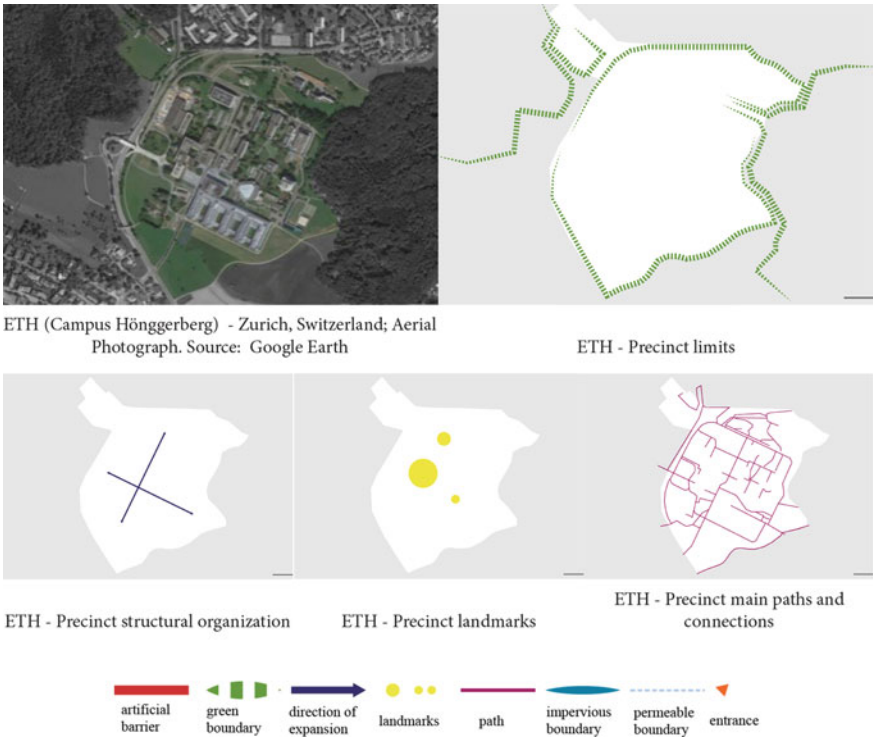


Figs. 2 to 6 Example analysis:Simon Fraser University

environments, following technological developments and the need to keep facilities up to date with the contents to be taught, led to the allocation of new facilities in the outskirts of cities. They are generally compact: all facilities belonging to the same institution are located in the same physical area and present low construction density (though in some cases there is already no more room for expansion, due to the enlargement of the adjacent city) and tend to present very clear and legible limits, reinforced by visually permeable barriers. Usually accessibility levels are low, and ease in access relies on private vehicles. The precincts tend to be structurally uni- or bi-directional, concentrating its main landmarks in the central areas (Figs. 7 to 11).

(c) Inner precinct—*"Campus in the city"*

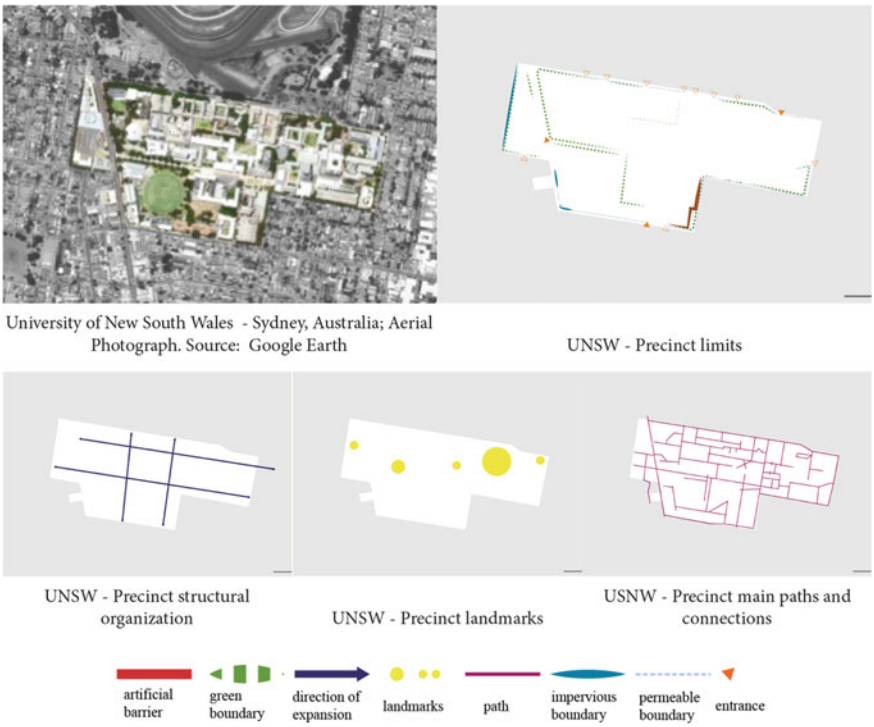
In this sub-category, the university precinct is located within an urban area, however it still maintains all functions and supporting activities. The precinct is incorporated in the urban fabric, in a more or less central and prominent location, nevertheless distinguishing itself from it, presenting a distinctive character from the surrounding environment. Usually this distinction is made through urban and architectural elements, which tend to present disruptive features.



Figs. 7 to 11 Example analysis: ETH Zurich

These precincts tend to be highly accessible and identifiable, assuming prominent positions within the urban fabric. Regularly their boundaries are permeable or see-through making them inviting elements for the exterior community. Besides, the fact that they host all the functions related to the presence of people allow them to host connections between campus users and the outside community, as long as the promoted activities are open to the public in general. Some universities have established positive and profitable partnerships with the municipality they are located at for allowing the general public to use its facilities for a diverse range of activities (Benneworth et al. 2010).

These precincts have a tendency to somehow adjust to the morphological features of the adjacent urban fabric, either by mimicking the scale, pursuing the same visual continuities or any other urban trait, while differencing themselves from the surrounding environment and establish a clear precinct demarcation. Regardless, their location impacts on their morphology, establishing connecting nodes with the adjacencies. Inner precincts tend to follow urban fabric, so it is very common to observe orthogonal grids as structural order. Landmarks are usually located in visible places, and are often used as attractors (Figs. 12 to 16).



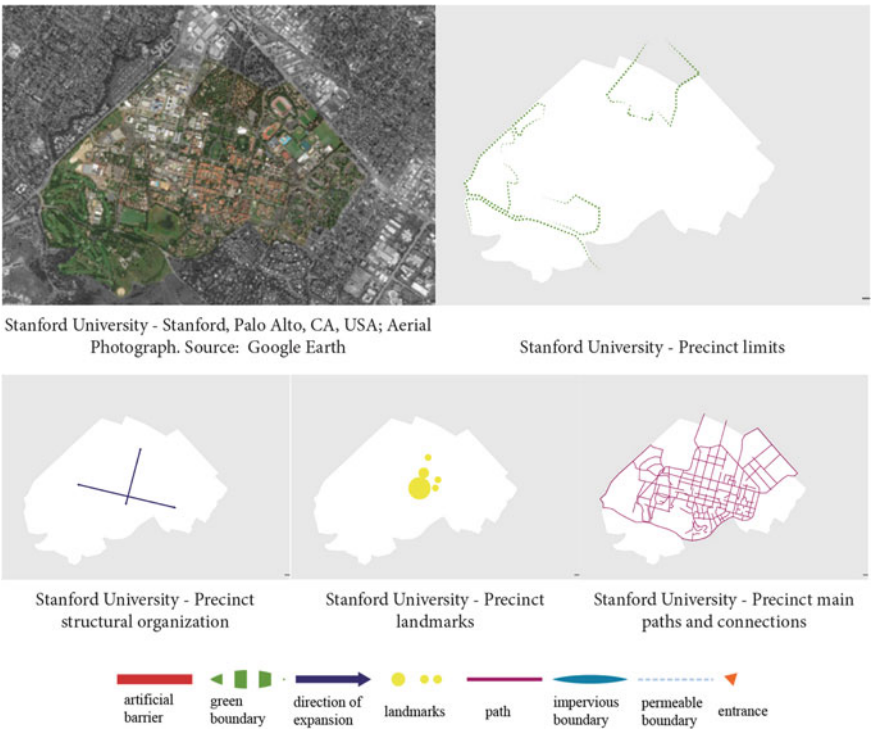
Figs. 12 to 16 Example analysis:University of New South Wales

(d) Developer precinct—*"Campus as a city"*

In this sub-category, the hosting city depends on the campus more than the other way around. This is the case of the largest land-grant universities, for instance, or of universities that have greatly contributed to the development of its hosting urban area (not necessarily a city). Universities precincts were placed in very small urban settlements, or in rural areas, and the city started developing and spreading through the university, and the inhabitants and businesses that came associated to it.

These large-scale precincts tend to host a high percentage of the global population of the settlement, offering all the required living functions. They assume very prominent positions in the urban fabric, that surrounds and develops concentrically from them. They act as structural elements in the settlement, which would not have existed (or, at least, not have developed to its current status) without the university precinct.

Even though they tend to be very clear and easily read as a whole, their boundaries are usually permeable or non-existent. There is a tendency for their construction density to be lower than in the adjacencies.



Figs. 17 to 21 Example analysis:Stanford University

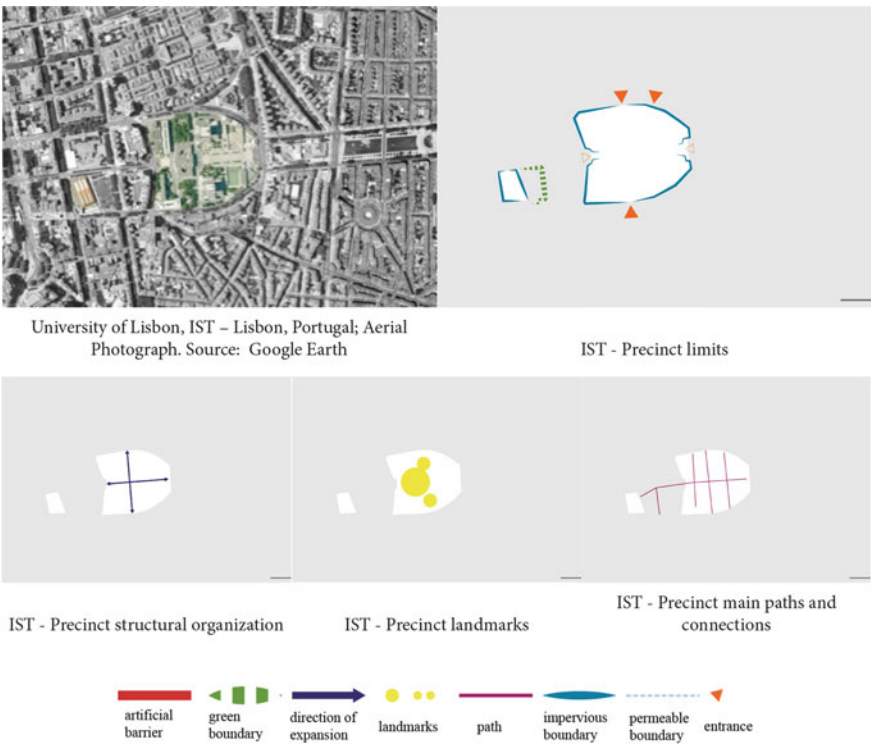
The precincts tend to generate urban fabric, so it is common to observe a structural center of the precinct, where landmarks are located, and from which the rest of the premises develop, in more or less structured and organized layouts (Figs. 17 to 21).

4.2 University as a Rooted Entity

In the following four sub-categories, the university relies on the city to fulfil some of the necessities of its users. In the described cases, universities are not autonomous or independent from their hosting city. They do not host the residential function in campus, neither any associated functions. Nevertheless, in some cases, leisure facilities are included, and universities promote a variable and lively cultural life in and off campus.

(e) Self-enclosed precinct—*"City around the campus"*

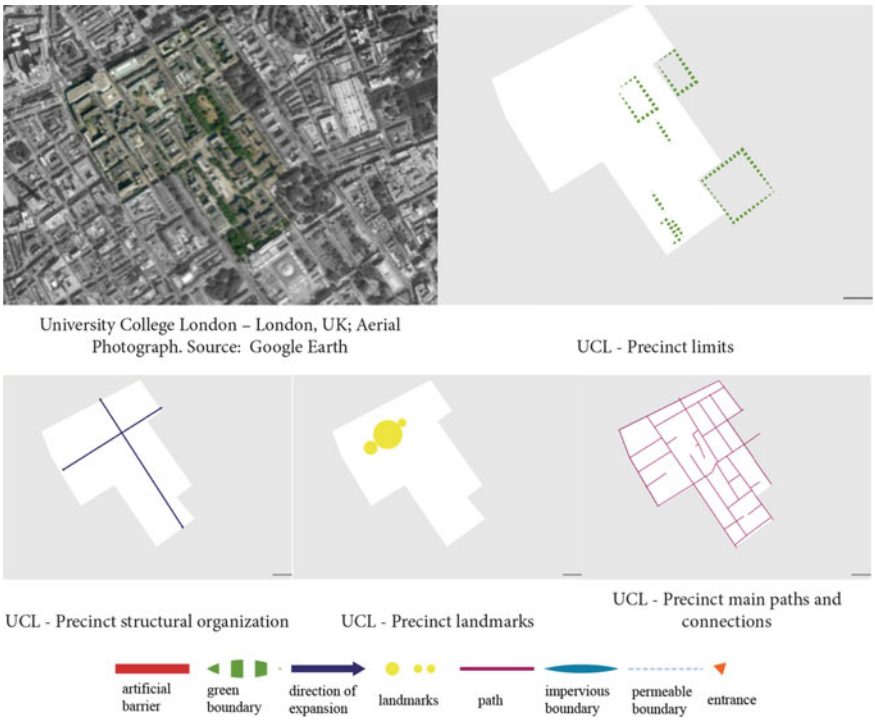
In this sub-category, the university is fully incorporated in the urban fabric—even though not necessarily located in a central area—and assumes a dominant position towards the adjacent territory. This prominent deployment comes associated with an inwards-focused posture, and the university seeks a certain degree of isolation although being located in highly accessible and visible areas. The precinct assumes a self-enclosed posture, reaffirming its position through morphological traits that promote its insulation and seclusion, such as walls and fences. It tends to be highly compact and densely built within its land plot. In some cases, the lack of land to spread required the creation of alternative precincts or the use of surrounding buildings and offices. Even so, the precinct is still very clear to remark due to its barriers and the legibility and visibility of its limits. These precincts tend to be inward focused. Structurally they tend to rely on a rigid organization, commonly recurring to gridded or bi-directional systems. Landmarks are usually located in highly visible and prominent places, assuming a strong character. These precincts host mostly academic related functions and some leisure facilities. The city provides all the facilities for living activities (Figs. 22 to 26).



Figs. 22 to 26 Example analysis:IST, Lisbon

(f) Open precinct—*"City in the campus"*

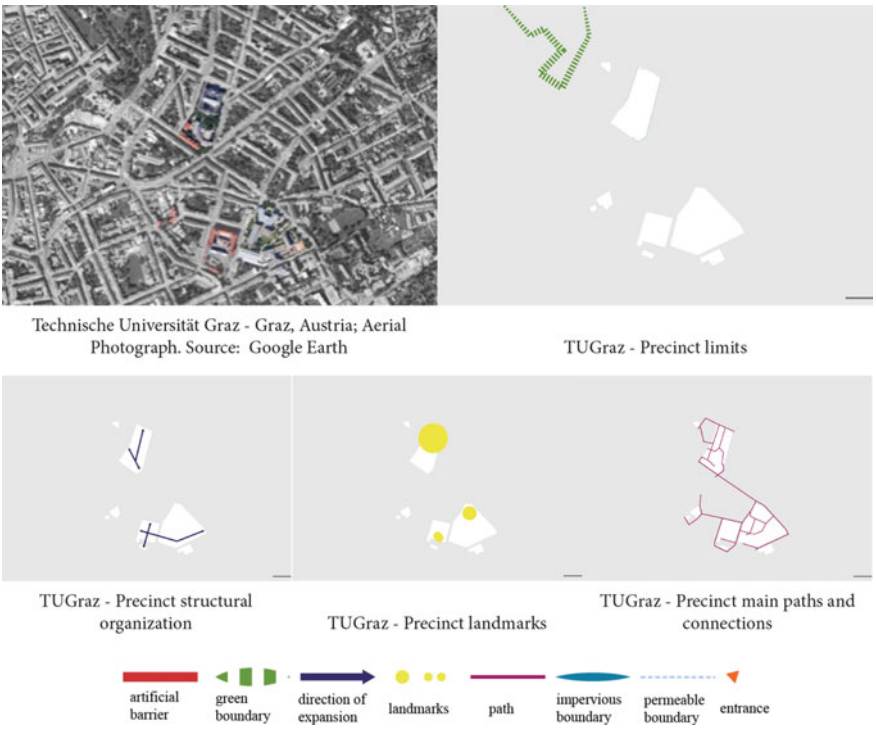
This sub-category is centrally located as the previously described. They differ mostly in character, since in this case, the university precinct is open, and establishes itself as part of the urban fabric. Its morphology may follow or differ from the surroundings, nevertheless, to an outside user, the campus can be perceived as just continuous urban fabric, and the university might pass unnoticed. The main distinguishable trait that characterizes this typology is the absence of barriers in the urban space, that is, the buildings might be private, but they behave exactly as the buildings in the vicinity, avoiding fences and segregation elements. This precinct is completely embedded in the urban fabric, establishing morphological continuity relations in scale, main sightlines and pathways, construction density or volumetric relations and proportions. Architectural typologies, yet, may vary, and in some cases are used to establish a difference from the surrounding environment. These precincts tend to follow urban fabric, so it is very common to observe orthogonal grids or organic shapes as structural order. Landmarks either can occupy central areas or be scattered, according to the time of construction of each building, but usually they are visible and accessible (FIgs. 27 to 31).



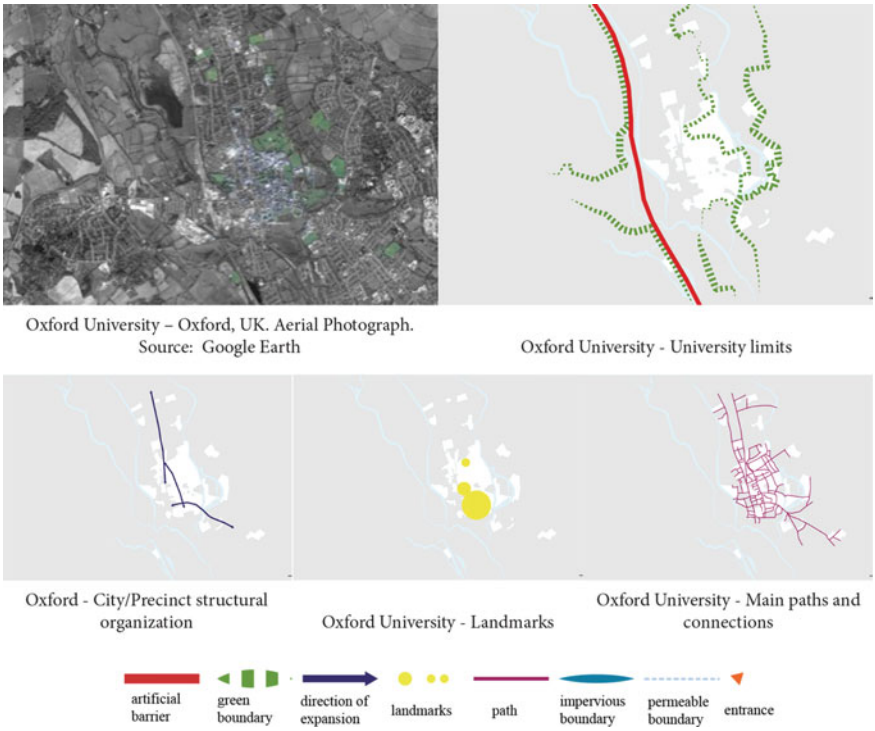
Figs. 27 to 31 Example analysis:UCL, London

(g) Scattered precinct—*"City as the campus"*

This sub category, highly popularized in Europe, comprises all cases in which the university is scattered through the city in a variety of independent buildings, following the nearly spontaneous physical distribution mostly used by German universities (Campos Calvo-Sotelo 2005), in which universities occupied existing buildings. The distance among them may range from vicinity to broader distances. There is no clear precinct, but a sum of independent buildings instead, even when they are located in geographic proximity. These precincts are part of the urban fabric, and consequently they do not establish any disruption from it. Landmarks are usually scattered, and are used as promoters for the university. They allow for the university to become more visible in the territory, and are usually inviting to the exterior community (Figs. 32 to 36).



Figs. 32 to 36 Example analysis:TU Graz



Figs. 37 to 41 Example analysis:Oxford

(h) Ubiquitous precinct—*"City is the Campus/Campus is the city"*

University and city are completely blended. It is the mix between "town and gown", in which one does not live without the other, but instead they have coalesced and developed together at the same pace. It is represented by cities as Cambridge or Oxford, in which city and university are absolutely dependent towards one another. Morphologically there is no difference between civic buildings and public space and university areas. Architectural styles follow times of construction and not necessarily one specific style, generating a fabric that is intrinsically urban, even when it is university property. In this case, the university is part of and generates the urban fabric, and consequently follows and adjusts to it. Landmarks are usually scattered, and are used as visibility enablers for the university. They are usually attractive and welcoming towards the exterior community (Figs. 37 to 41).

The main characteristics of the described types of precincts are synthetized in the following Table 2.

Table 2 Precinct types and characteristics

Precinct type	Autonomous precinct "Campus without the city"	Attached precinct "Campus edging the city"	Inner precinct "Campus in the city"	Developer precinct "Campus as the city"	Self-enclosed precinct "City around the campus"	Open precinct "City in the campus"	Scattered precinct "City as the campus"	Ubiquitous precinct "City is the campus/Campus is the city"
Dominance	University	University	University	University	City	City	City	City
Functions	Live Learn Play	Live Learn Play	Live Learn Play	Live Learn Play	Learn Play	Learn Play	Live Learn Play	Live Learn Play
Location	Secluded	Peripheral	Incorporated	Central	Incorporated	Central	Interspersed	Global
Compactness	Compact	Compact	Compact	Compact	Compact	Compact	Diffuse	Diffuse
Density	Low	Low	High	Medium	High	Medium	Medium	Medium
Limits	Clear	Clear	Perceptible	Perceptible	Clear	Inexistent	Inexistent	Inexistent
Accessibility	Low	Low	Medium	High	Medium	High	High	High
Focus	Inward	Inward	Outward	Outward	Inward	Outward	Outward	Outward

5 Conclusion

This paper aims at providing insight on universities' morphological traits and their impact on the ability to generate local synergies, based on direct connectivity relations.

Some trends in terms of spatial organization can be observed. Urban precincts tend to be less compact but more densely built, even though we can observe that, when the precinct evolves synchronously with the city, their densities tend to be closer. As far as limits are concerned, two different trends are identified. They are not related to the location of the precinct, but connected to the university charisma at the time the precinct was developed. However, most universities seek some degree of seclusion, in order to shelter themselves from the city.

A tendency towards a more vibrant community engagement and stronger participation in urban dynamics was also observed in universities that showed no to permeable barriers towards the adjacent territories. However, it is possible to achieve the same connections with a more secluded precinct, as long at the proper investments in the third strand mission of the university are made, and that both the university community and the civil society participate in mutual activities.

It is, although, difficult to limit the variables while analyzing universities, since it is impossible to measure the exact degree of the impact of the physical premises in enabling relationships between the university and its environs. Yet, this research advocates that the physical space does matter and that it can be used as a powerful tool to enable fruitful connections, both at the learning environment scale and at the urban scale.

The university precinct faces the responsibility of, simultaneously, hosting all the activities consentaneous with intellectual development and knowledge creation, while exemplifying positive behaviors towards society, being an illustration of inclusiveness and sustainable development, without losing its charisma or character, but maintaining its necessary secludedness and independency.

This analysis has shown encouraging results, for the possibility of comparing several cases and, from them, drawing conclusions regarding the positive morphological traits of university precincts. Further developments may include design guidelines and best practices in order to achieve integration goals in university facilities.

Acknowledgments This paper was carried out in the framework of the author's PhD research, funded by FCT—Fundação para a Ciência e a Tecnologia and funded by FLAD - Fundação Luso-Americana para o desenvolvimento. We are thankful to FLAD and FCT for supporting our work.

References

Adhya, A. (2010). College towns as a model of sustainable placemaking: Learning from two successful college towns in small metropolitan regions. In *AIA Report on University Research Volume 5*.

Bacharel Carreira, M. (2015). *In-between formality and informality learning spaces in university context*. Universidade de Lisboa.

Barnett, R., & Temple, P. (2006). *Impact on space of future changes in higher education*. Bristol.

Benneworth, P., Charles, D., & Madanipour, A. (2010). Building localised interactions between universities and cities through university spatial development. *European Planning Studies, 18* (10), 1611–1629.

Fouchier, V. (2012). Économie de la connaissance et aménagement universitaire dans les métropoles du monde. In P. Ingallina (Ed.), *Universités et enjeux territoriaux Une compairaison internationale de l'économie de la conaissance* (p. 320). Villeneuve d'Ascq: Presses Universitaires du Septentrion.

Futures, Building. (2009). *Growing by degrees: Universities in the future of urban development*. London: RIBA.

Caldenby, C. (2009). Universitetet og Byen—To traditioner/The university and the city—Two traditions. In M.H. Samsøe. (resp.), C. Schmidt & H. Glyng (photos) (Eds.), *Campus og Studiemiljø—fysiske rammer til morgendagens universiteter|Campus and Study Environment—physical framework for universities of the future*. Copenhagen: The Danish University and Property Agency under the auspices of the Danish Ministry of Science, Technology and Innovation.

Campos Calvo-Sotelo, P. (2005). *Villanueva de la cañada*. ELECÉ Industria Gráfica, S. L.: Ciudad del saber. Madrid.

Campos Calvo-Sotelo, P. (2009). An innovative concept for the transformation of Universities and their relation to Cities: The 'Educational Campus'. In *OECE—Riga*. Riga.

Corneil, J., & Parsons, P. (2007). The contribution of campus design to the knowledge society: An international perspective. In K. Christiaanse & K. Hoeger (Eds.) *Campus and the city—Urban design for the knowledge society*. Zurich: gta Verlag, ETH Zurich.

Filion, P., Hoernig, H., Bunting, T., & Sands, G. (2004). The successful few: Healthy downtowns of small metropolitan regions. *Journal of the American Planning Association, 70* (December 2014), 328–343.

Gensler (2012). *Changing Course. Connecting Campus Design to a New Kind of Student*.

den Heijer, A. (2011). *Managing the university campus—Information to support real estate decisions*. Delft: Eburon Academic Publishers.
Heitor, M. (2012). How far university global partnerships may facilitate a new era of international affairs and foster political and economic relations? In: *ASHE international forum 2012*. Las Vegas.
Heitor, T. V. (2000). Strategies for Social Sustainability Through the Built Environment: A Comparative Study. In P. Conceição, D. Gibson, M. Heitor, & Syed Shariq (Eds.), *Science, Technology, and Innovation Policy - Opportunities and Challenges for the Knowledge Economy* (pp. 531–543). Westport, CT, London: Quorum Books.
de Holanda, F. (2010). Sociological architecture—A particular way of looking at places. *The Journal of Space Syntax, 1*(2), 337–355.
Indovina, F. (1997). Sinergi Tra Communità e Università. *Archivio di Studi Urbani e Regionali, 28/29* (60/61), 85–114.
Knight, R. (1995). Knowledge-based development: Policy and planning implications for cities. *Urban Studies, 32*(2), 225–260.
Lundvall, B.-Å. (2004). The economics of knowledge and learning. In J. Christensen & B.-Å. Lundvall (Eds.), *Product innovation, interactive learning and economic performance: Research on technological innovation, management and policy* (p. 226). Amsterdam: JAI Press.
Lundvall, B.-Å. (2009). *Why the new economy is a learning economy*. Aalborg: DRUID Danish Research Unit for Industrial dynamics.
Mitchell, W. J. (2007). *Imagining MIT—Designing a campus for twenty-first century*. Cambridge, MA: MIT Press.
Temple, P., & Barnett, R. (2006). Higher education space: Future directions. *Planning for Higher Education, 36*(1), 5–15.
Turner, P. (1984). *Campus: An American planning tradition*. Cambridge: MIT Press.
Wiewel, W., & Perry, D. C. (2008). *Global universities and urban development. Case studies and analysis*. New York. Armonk, New York: Lincoln Institute of Land Policy.
Williams, L., Turner, N., & Jones, A. (2008). *Embedding Universities in Knowledge Cities: An Ideopolis and Knowledge Economy Programme paper*, pp. 1–57.
Van Winden, W. (2010). Knowledge and the european city. *Tijdschrift Voor Economische En Sociale Geografie*, *101*(1), 100–106.
Witty, A. (2013). *Encouraging a British Invention Revolution: Sir Andrew Witty's Review of Universities and Growth*. London.

Author Biographies

Luísa Cannas da Silva is an architect and PhD student at Instituto Superior Tecnico, University of Lisbon.

Her research interests include urban morphology and urban planning, using space-use analysis and post-occupancy evaluation tools. Her on-going PhD thesis focuses on the morphological traits of university precincts and the impact of university morphology in the connections between University and City, linking the built environment with behavioral and social outcomes.

Teresa V. Heitor is Full Professor of Architecture at Instituto Superior Tecnico, University of Lisbon. She is an architectural researcher specializing in architectural programming and briefing, and post occupancy evaluation, making use of space-use analysis tools. Research emphasis is placed on the development of form-models function and self-assessment tools grounded on a critical evidence base. Her recent research and teaching explore the links between spatial properties of the built environment and behavioral and educational outcomes. Since 2005 she integrates the OECD Group of National Experts on Evaluation of Education Facilities (GNEEEF).

Increasing Student Participation and Engagement in Sustainability Projects in Universiti Sains Malaysia (USM) Through *Kampus Sejahtera* and *WSU101: Sustainability Course for Undergraduates*

Noor Adelyna Mohammed Akib, Suzyrman Sibly, Mohd Sayuti Hassan, Radieah Mohd Noor, Kanayathu Chacko Koshy and Kamarulazizi Ibrahim

Abstract

In 2008, Universiti Sains Malaysia (USM) which re-aligned its major and long term focus towards sustainability was selected by the Ministry of Education, Malaysia to participate in the Accelerated Program for Excellence (APEX), a fast track program that would help the university achieve world-class status. In order to mainstream sustainability within the campus, increased student participation and engagement in sustainability projects are essential. One of the easiest ways to encourage student participation and engagement in sustainability is through co-curricular and extra curricular activities. This paper presents a concentrated analysis on how USM increases student participation and engagement in sustainability projects in campus through its co-curricular and extra curricular activities specifically the WSU101 *Sustainability Course for Undergraduates* and the *Kampus Sejahtera* program. A special emphasis is given to the challenges and barriers that affect student participation and engagement in sustainability projects. Finally, the paper highlights the lessons learnt as well as the successful strategies implemented to ensure increased student participation and engagement in sustainability projects. This paper will be useful to anyone interested to increase student participation and engagement in sustainability projects in their respective institutions of higher learning.

Keywords

Sustainability projects · Universiti Sains Malaysia · Problem base student centred learning (PBSCL)

N.A.M. Akib (✉) · S. Sibly · M.S. Hassan · R.M. Noor · K.C. Koshy · K. Ibrahim
Centre for Global Sustainability Studies, Universiti Sains Malaysia, 11800 USM Gelugor, Penang, Malaysia
e-mail: adelyna@usm.my

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_20

1 Introduction

Sustainability is such a broad and wide ranging issue, it covers from all aspects of the sciences and the social sciences. Thus, when we discuss on sustainability issues, we will relate these issues to sustainable development. Sustainable development is to achieve development by alleviating poverty and narrowing the gap between the rich and the poor without causing adverse effects on the functioning of the Earth's ecosystem. It is an important concept that requires integration in the country's economic, environmental and social components through the practice of limitation and balance. If there is no integration within all the factors, we will be left with a country with excellent economic development, but with devastating environment, thus affecting the livelihood of the community especially the poor.

The World Summit on Sustainable Development in Johannesburg has identified Water, Energy, Health, Agriculture and Biodiversity (WEHAB) as five critical sectors in sustainability (United Nations 2002). Through rigorous research in all these sectors, Universiti Sains Malaysia shall continue to improve the lives and human well-being while protecting our vulnerable ecosystem from being continuously compromised. In addition to WEHAB, particular attention needs to be paid to (i) Climate change, variability and disaster management, (ii) Production and consumption and (iii) Population and poverty. There are also implementation challenges associated with ICT, governance, security, trade and the financing context (Universiti Sains Malaysia 2014).

As a means to assert our paradigm to be in line with 'sustainable development', we believe in educating our future generations to be fully refined on this subject. Thus, it is essential to mainstream sustainability within the campus by increasing student participation and engagement in sustainability projects through Problem Base Student Centred Learning (PBSCL). By introducing co-curricular and extra-curricular activities specifically the WSU101 *Sustainability Course for Undergraduates* and the *Kampus Sejahtera* programmes, we are determined to mainstream sustainability in our campus.

2 Background

In 2008, Universiti Sains Malaysia (USM) which re-aligned its major and long term focus towards sustainability was selected by the Ministry of Education, Malaysia to participate in the Accelerated Program for Excellence (APEX), a fast track program that would help the university to achieve its world-class status (Universiti Sains Malaysia 2008). In order to mainstream sustainability within the campus, increased student participation and engagement in sustainability projects are essential. One of the easiest ways to encourage student participation and engagement in sustainability is through co-curricular and extracurricular activities. These activities involve students to participate in the problem base student centred learning which was

initiated by USM to encourage students to learn about sustainability and practice sustainability in their everyday lives.

Problem Base Student Centred Learning (PBSCL) is defined as a 'classroom' where students are actively involved in the learning process and the focus now is on the students, rather than on the teacher. Citing from Savery (2006) "Problem base learning or PBL is an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem". This is a knowledge base skill and students (or learners) are able to develop both problem solving strategies and become a problem-solver. There are three characteristics needed in creating an effective learning environment (Combs 1976); (1) the atmosphere should facilitate the exploration of learning, (2) learners must be given frequent opportunities to confront new information and experiences in the search for meaning; and (3) new meaning should be acquired through a process of personal discovery.

Gone were the days, as we call it 'traditional education practices', where students are faced with a massive amount of information in memorising and sitting for an exam to evaluate their understanding in certain subjects. The setbacks of the traditional method is students often forget what they learned and sometimes they memorise a subject that do not apply in their everyday lives. By giving them the opportunity to become the problem solver, they can relate many issues on sustainability and understand the issue better.

Although the traditional practices still apply in most educational institution's methods of teaching, including USM, we believe in shifting that practice into a PBSCL so the students could acquire optimum benefits from this course.

In USM, we have taken the initial steps in shaping our future graduates to become a problem solver. In this environment, students will move away from following orders given by their teachers to self-directed learning activities. They have the opportunity to communicate and take responsibility for their learning instead of listening and reacting to lessons, which is not considered viable in this past facing world of technologies. Information can be obtained at our fingertips and students should be allowed to experiment and test their understanding through PBSCL.

3 WSU 101—Sustainability Course for Undergraduates

The course, WSU 101—'Sustainability Issues, Challenges and Prospects' is an undergraduate course offered as an elective sustainability course to all USM students. This course was introduced in 2011/2012 academic session. In this course, the students were familiarised with the Concept of Sustainability. It emphasizes the implementation of sustainable development through the study of global case studies and examples drawn from sustainability program from around the world. In this

co-curricular, we based our education through problem base student centred learning (PBSCL) in educating the students in Sustainability.

To date we have 500 students registered in this program. The course outline is as follows:

- Sustainability concept
- Sustainable development: Issues, Implications and Studies
- Identifying unsustainable world
- Application of ESD in all disciplines
- Seminar/Forum on sustainability
- Final project followed by presentation

By guiding the students with the outline of the course, they are expected to demonstrate their level of understanding on sustainability issues through group projects and present their project at the end of their course. Some of the projects that the students undertook is looking at the diversity of trees in USM, the use of air-conditioner in USM, amount of waste produced in USM, parking lot assessments in USM and many more.

Additionally, this course aims to expose students to the latest developments in the sustainability studies agenda while nurturing the skills needed toward developing sustainable-oriented programs. The skills include holistic and systematic approaches, forming critical judgments on real life issues and finally they are able to collaborate in an interdisciplinary environment to achieve their goals towards sustainable development.

4 *Kampus Sejahtera* Program

In Malay language *Kampus* mean campus, while *Sejahtera* is a Malay word which has multiple meanings, including "peace, tranquility, harmony, wellness and health". Hence, *Kampus Sejahtera* covers sustainability of which will put the community in a balance with their natural environment and it is complementary.

Kampus Sejahtera was introduced by the former Vice-Chancellor, The Hon Prof. Tan Sri Dato' Dzulkifli Abdul Razak in 2001. Conceptually, the *Kampus Sejahtera* means a comprehensive guideline to the USM community, including the university administrations, academic, supportive staffs and also students in supporting and consistently upholds the tradition of this unique campus.

Under this concept, the University has outlined five (5) values to be nurtured within the University community. First, to create a new set of intellectual that are responsible in upholding the tradition of the University; Second, to create new spaces, whether physical or social infrastructures harnessed for academic career, competition and other processes involved in higher education; Third, to encourage students and the campus community to introduce the idea of 'sustainable development' (sustainable development) in the University, such as 'environmentally

friendly', 'walking culture' etc.; Fourth, to promote healthy and quality lifestyles within the campus community; and Fifth, *Kampus Sejahtera* supports all activities or programs that promote sustainability in the campus. Overall, programs under *Kampus Sejahtera* is a problem centred learning for students and all the projects involved the students' participation in solving everyday problem faced by the community in practicing sustainable lifestyle.

Some of the projects under *Kampus Sejahtera Programme* are listed below (Universiti Sains Malaysia 2008):

(i) *White Coffin Programme*

One of the examples is the famous *White Coffin Program* which is one of the series of student-centred activities. The *white coffin* referred to the white container made from polystyrene. This program became a flagship for environmental activism on the USM campuses. In 2007, a group of USM students put up an idea originally targeted at eliminating polystyrene containers on the campuses. Polystyrene containers have set to be harmful because it is non-biodegradable and it takes around 500 years to decompose. They also present some environmental issues because of its lightweight nature, they are likely to be blown from disposal sites when disposed of properly. Their lightweight and floatable properties made them travels easily through gutters and storm drains, eventually reaching the ocean. Thus, The White Coffin captures the imagination of everyone who sees it because it evokes strong feelings and emotions tied to the environmental pollution and also health risks from prolonged exposure to styrene.

Through this programme, we have succeeded in banning the use of polystyrene containers on all three campuses both at the cafeteria and for all events involving catering on the campuses. Although, we cannot claim 100 % success, but this program has become the rallying call in our effort towards sustainable campus by reducing consumption and waste.

Subsequent from the white coffin campaign, USM has conducted a follow up activities which is called the *tapau-mania* project. *Tapau* means takeaway, derived from a Hokkien dialect which is an intelligible Min Nan Chinese dialect spoken throughout Southeast Asia, Taiwan, and by many overseas Chinese. This project encourages the campus community to bring their own container to take away food from the cafeteria. The *tapau-mania* contest was held from 2 to 16 September 2008 and opened to all staff and students who bring their own container and eat at the canteen using reusable utensils. These two projects are one of the initiatives for sustainability projects and have gained many positive impacts since the start of the initiation and they are sustained by USM students.

(ii) *Campus-Wide Recycling Project*

This is another project to raise the awareness of students on recycling as one of the important elements in environmental sustainability. Throughout this programme, 70 students and university staff were exposed and trained on how to recycle and promote the activities among the entire campus community including e-wastes. This model of participation and training will be adopted by other sustainable development projects and programmes.

(iii) *Tree Planting Project*

Tree planting has become an annual activity during the orientation week of newly admitted students and in 2006 alone, some 600 trees were planted including varieties of local fruits.

(iv) *Citizenship Programme*

The objective of this programme is to train high school students to carry out problem solving activities in their communities. In this programme, students engage members of the community and identify problems in their residential areas or village. Apart from the community, the programme also involved local councils and other local authorities. They then propose possible solutions to some of the identified problems. In this process the students have to learn skills such as decision-making, communication and problem-solving that is important in real life.

Up till now as many as 5000 pupils from nearly 50 schools nationwide have gone through the educational training and processes, with the exploration of various issues from environmental to social issues. For it to be sustainable, a group of staff members within the university are now well-trained in conducting such projects.

Based on the success of these projects, USM is now replicating the same model to involve university students. This would definitely bring higher level of analysis and greater complexities of issues contributing to their development of better citizens.

(v) *Say No to Plastic Bags*

After the success of the *White Coffin Project*, USM has initiated the *Say No to Plastic Bags* campaign. Plastic bags caused environmental impacts which includes; danger to animal life especially when they find their way into the sea because they are commonly mistaken as food by animals; the amount of plastics in world's ocean has increased dramatically and there is a Pacific Trash Vortex which is a 'gyre' of vortex of marine litter in the North Pacific ocean; and, plastic bags are used for a short period time, but take hundreds of years to break in landfill because most of them are not biodegradable. Furthermore, data released by the United States Environmental Protection Agency show that somewhere between 500 billion and a trillion plastic bags are consumed worldwide each year (National Geographic News

September 2, 2003). With these many reason USM had started a campaign to lessen the use of plastic bag in the campus. This campaign aims to discourage the USM family in using plastic bags for many purposes and it is hoped that plastic bags will be treated similarly to polystyrene containers. For this purpose, a total ban on using plastic bags at USM canteens was enforced on August 1st, 2008. Subsequent from this, the *No Plastic Bag Day* was initiated on January 1st, 2011 by the Ministry of Domestic Trade, Cooperative and Consumerism (MTDCC) with the objective to reduce the excessive consumption of plastic bags and save the environment (MTDCC 2012). The campaign imposes a MYR 0.20 cents (USD 0.05) charge per plastic bag. Succeeding from this too, some of the state governments in Malaysia also took the initiatives in banning the total use of plastic bags e.g. Penang State Government and Malacca while most of the states banned plastic bags on the weekends.

(vi) *Green Lung and Tobacco Free-USM*

Another project initiated by the Kampus Sejahtera is 'Green Lung'. The Green Lung is a Youth Grassroots movement empowering youths as the agents of change in advocating a tobacco-free environment not only on campuses but also in the Malaysian community as a whole. This special interest group was initiated by USM students from the School of Pharmaceutical Sciences in December 2009. Green lung was officially launched in USM on 23rd February 2010. After that, a total of four universities in Malaysia which are, Universiti Kebangsaan Malaysia, Universiti Malaya, Universiti Teknologi MARA and International Islamic University Malaysia has shared the same vision and have joined forces to advocate for a tobacco free environment. Subsequent from the 'Green Lung Project' USM started a 'Tobacco-Free USM', a collaborative effort between the Division of Industry and Community Network (BJIM) and the National Poison Centre (PRN), serious effort in ensuring all four USM campuses implement the Tobacco-Free Policy starting from January 1, 2013. This project is in line with the Tobacco Products Control Regulations 2004, which lists 21 non-smoking areas and will contribute towards a healthy campus community.

(vii) *Going Bananas Project*

The Going Bananas Project was initiated to assist in raising the living standards of the community in Balik Pulau, Penang via the production of handmade paper from banana plants. The project goes through several stages of the processes of planting, harvesting and finally extracting the banana trunk fibers, which is then beaten to a pulp and treated until a sheet of paper is made. The sheets were then used for handicrafts, souvenirs as well as interior decorations, Handicrafts made from paper of the banana trunks and other raw materials are now a major component of the cottage industry in Malaysia. In terms of economics, banana paper also has potential to have a positive impact on commercial and industrial demand for an environmentally safe source of raw material.

(viii) *Reducing Flood Related Challenges through ESD in Kuala Nerang, Malaysia*

This project looks at the relations between the flood-related issues using the vulnerability and adaptation methods to identify the vulnerable groups to food security. This project is aimed to enable the residences of the northern part of Malaysia to have a better preparation to face flood situations and to reduce the risk of flooding.

Throughout this project, people in the chosen area were trained on measure to reduce flood risks. The flood pattern of the region was also studied as it will help the researchers and the residences on adopting more appropriate strategies in facing floods in the future. Different governmental institutions and organisations are involved in the project, both districts and state levels. The cooperation between these two institutions enables residences to face flooding situations with better preparation.

To run this project, the participatory approach method has been adopted by conducting several workshops and focus group discussions. Students from various schools participated in the flood awareness campaign and were also trained in handling the flooding situation and preparations expected to be done during the flood crisis.

This project was awarded the certificate honour by RCE Global for its contribution in advancing community engagement, transdisciplinary action research in ESD.

5 Conclusion

Problem base student centered learning should become the essence as one of the learning tools for all students. By learning from examples from the two programs it has captured the skills and capabilities of the students to solve problems by engaging them in an activity and triggering them to explore many dimensions of the environmental using all their senses. Through multiple observation and recording of information, they generated ideas and feelings about a certain topic, in this case in achieving sustainable development. By participating in this program, we have produced critical and creative thinker on environmental challenges and opportunities.

As the University with the Research University (RU) and Accelerated Programme for Excellence (APEX) status we set ourselves to 'Dare to be Different' because catching-up with established universities in the world is a tough challenge. We chose to become a world renowned university in sustainability and embrace the PBSCL as a way of teaching our students about sustainability.

References

Combs, A. W. (1976). Fostering maximum development of the individual. In W. Van Til & K. J. Rehage (Eds.), *Issues in secondary education*. (NSSE Yearbook, 1976). Chicago: National Society for the Study of Education.

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem-Based Learning*, *1*(1). Available at doi:10.7771/1541-5015.1002

United Nations. (2002). *United nations a framework for action on health and the environment*. New York: WEHAB Working Group UN.

Universiti Sains Malaysia. (2008). *Transforming higher education for a sustainable tomorrow*. Malaysia: Penerbit USM.

Universiti Sains Malaysia. (2014). *USM policy on sustainability*. Malaysia: Centre for Global Sustainabilit Studies, Universiti Sains Malaysia.

Authors Biography

Dr. Noor Adelyna Mohammed Akib currently holds a position as a Senior Lecturer at the Centre for Global and Sustainability Studies, Universiti Sains Malaysia. She obtained her Ph.D. which specialised in Population Genetics from Universiti Sains Malaysia, Penang, Malaysia in 2014. Her main focus is in the conservation and management of fisheries using molecular markers as a complement to the traditional methods in promoting sustainable fisheries practices. She has been involved in multiple works on DNA Barcoding and was invited to teach researchers and students in statistical methods in genetics for DNA Barcoding and impart her knowledge on BOLD (Barcode of Life Data) systems, both locally and overseas namely, Iran and Vietnam.

Dr Suzyrman Sibly received his Ph.D. in Economics from the University of Newcastle Upon Tyne, United Kingdom. He has taught courses in Introduction to Economics and Microeconomics in the School of Distance Education. He has authored articles in the Management and Decision Economics journal and the Higher Education Research Monograph (NAHERI). He has also been involved in a number of consultancy type as well as fieldwork type research projects such as the Enhancing The Quality of Faculty in Private Higher Education Institutions (PHEIs) in Malaysia project, The Malay Indigenous Entrepreneur Information System under Penang Regional Development Authority (PERDA) project and conducted data collection for The Wellness and Quality of Life: Tackling Lifestyle and Health Issues using New Technologies in Penang and Kelantan project.

Dr. Mohd Sayuti Hassan is the Senior Lecturer of the Centre for Global Sustainability Studies (CGSS), Universiti Sains Malaysia. Graduated with B. Sc in Computer Science from Universiti Sains Malaysia. He holds a Master's Degree in Transport Tourism, from Universiti Sains Malaysia and PhD in Sustainability Tourism from Universiti Kebangsaan Malaysia. As a Lecturer and Researcher at the CGSS, he helped develop the Sustainability Center to contribute through education for sustainable development, scientific assessment, policy research and capacity-building to the efforts of resolving pressing problems that is confronting the Malaysian society and the global community today and the future. He also have a solid understanding of software development life cycle processes including requirements gathering, analysis and design, development tools and technologies, release and version control, contemporary testing methodologies and deployment management. Experience with software project planning and management including web application development projects, and software development process improvement.

Dr Radieah Mohd Noor is a Senior Lecturer at Centre for Global Sustainability. Graduated with B. Sc in Social Science (Hons) from Universiti Sains Malaysia, Master of Social Science (Islamic Development Management) from Universiti Sains Malaysia; and PhD in Islamic Development Management from Universiti Sains Malaysia. Her expertise is in Development Economics, Human Resources and Islamic Economics.

Professor Kanayathu Chacko Koshy is the former Professor of Sustainability at the Centre for Global Sustainability Studies (CGSS), Universiti Sains Malaysia, Penang. He was the former Professor of Environmental Chemistry at The University of the South Pacific in Fiji and the Foundation Director of the USP's Pacific Centre for Environment and Sustainable Development. Dr. Koshy was also the Director of the Pacific Centres of the global change research networks—START, the System for the Analysis, Research and Training, Washington D.C. and APN, Asia Pacific Network for global change research, Kobe. Before joining The University of the South Pacific, he was a Faculty Member of the University of the West Indies, Jamaica, and the State University of New York at Buffalo. He was the principal investigator of the Asia-Pacific Cultural Centre for UNESCO, European Union, Global Environmental Facility, and AusAID sponsored climate change projects for the Pacific. His current responsibilities involve capacity building, research, and professional networking at the national regional and international level.

Professor Kamarulazizi Ibrahim is the Director of the Centre for Global Sustainable Studies at USM and in involve heavily in sustainability research and policy matters at the local, national, regional and international levels, especially the UN system bodies. In addition, he is a Professor at the School of Physic in charge of Semiconductor Fabrication Processes and Characterization, Solar Cells, Cleanroom and Nanotechnology. He is also the Chairman for the Energy Research Program, Nano Optoelectronic Research and Technology Laboratory (NOR) and a Senate member of USM. He was the Coordinator for Energy Research Group USM, (1989–1992), Chairman for Pure Physics and Education, (1992–1997) and Master Trainer, Logical Frame Approach (LFA), USM (2002–2004). As the Director of the Centre for Education Training and Research Renewable Energy and Energy Efficiency (CETREE), USM (2000–2008) he was responsible for increasing knowledge and awareness of the role of renewable energy and energy efficiency for professionals, schools, tertiary institutions, schools and also to the public in Malaysia. He has travelled, lectured and published widely in Energy, Semiconductor Materials and Devices, Nanotechnology, and Sustainability field.

A Holistic Approach for Integration of Sustainable Development in Education, Research, Collaboration and Operations

Göran Finnveden, Erica-Dawn Egan, Teresia Sandberg and Emma Strömberg

Abstract

In 2011 KTH Royal Institute of Technology started several new sustainable development initiatives. This paper will report on the journey. An Environmental Management System for the entire university has been established and KTH became ISO 14001 certified during 2015. The system includes operations but also education, research and collaboration. In this way we ensure that sustainability goals are integrated in the management system and that improvements are required continuously. For education an aim is that all educational programs should be able to report how they have integrated sustainability. The activities are focused on two complementary approaches: evaluation of the program's work and providing tools and support for teaching staff and program directors. Preliminary results from the on-going evaluation indicate that progress has been made in several programs, but there is still room for improvements. For research, several bibliometric and external funding indicators show progress. During the winter of 2015 an evaluation was conducted and based on this it was decided that the activities should continue. A new policy for sustainable development as well as new sustainable development goals were decided during 2015.

Keywords

Education · Research · Environmental management system · Sustainable development · Collaboration

G. Finnveden (✉) · E.-D. Egan · T. Sandberg · E. Strömberg
KTH Royal Institute of Technology, Stockholm, Sweden
e-mail: goranfi@kth.se

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_21

1 Background

Governments around the world have agreed on a global agenda for sustainable development (UN 2015). In order to reach the universal sustainable development goals, the role of universities is crucial. There have been many initiatives to integrate sustainable development into the systems of Higher Education Institutions (HEIs) (Ramos et al. 2015). Unfortunately many of those initiatives addressed only one or two of the system's elements which tend to foster compartmentalisation due to the complex nature of many universities (Lozano et al. 2015). A large number of academic papers have been published on the integration of sustainable development in HEIs but most of them focus on one aspect, e.g. education (ibid.). This paper describes a case where a broad initiative covering all aspects of the university's activities is ongoing.

KTH Royal Institute of Technology is Sweden's oldest and largest technical university. It has approximately 5000 staff and 15,000 students. KTH is divided into ten schools and the University Administration. Each school is led by a Dean and the University Administration is led by the University Director. The President appoints Vice-presidents for specific tasks. The Faculty Council is responsible for the quality of KTH's education and research and is led by the Dean of Faculty.

According to the Swedish Act on Higher Education, universities shall promote a sustainable development. As a governmental agency, KTH is also required to have an Environmental Management System. In order to get a basis for further decisions, KTH's President appointed in 2010 a working group to map and evaluate KTH's accomplishments within the areas of the environment and sustainable development relative to KTH's policy at the time for sustainable development and associated action plan. KTH's work was also compared to the work of other Swedish universities as well as to international universities. The resulting report showed that, compared to its ambitions, KTH underperformed in this area with regard to campus work, education, research and visibility in media (KTH 2010).

Based on the evaluation report, KTH in 2011 formulated several new initiatives in the field of the environment and sustainable development. The aim of this paper is to describe these initiatives, some of the activities undertaken and results. The focus will be on education, research and collaboration. The paper summarises the development during the period 2011–2015, also describing some lessons learned and future developments. The paper serves as a case study which can be useful also for other universities who plan to make a similar journey.

2 Organisation of KTH's Central Sustainability Work

As a part of the initiatives taken in 2011, the strategic and practical work with environment and sustainable development was divided into two areas: KTH-Sustainability and Sustainable Campus where KTH-Sustainability was responsible for education, research and collaboration; and Sustainable Campus was

responsible for the university's internal environmental management. The same year a Vice-president for Sustainable Development was appointed and an Environmental Manager was recruited. Both positions were new to KTH's organisation.

KTH-Sustainability was organised as project with a budget of approximately 440,000 Euro per year. Approximately half of the budget has been used for personnel working for KTH-Sustainability and half has been used to fund different projects performed by the Schools. The goals and activities of KTH-Sustainability were outlined in a project plan which was approved by the President of KTH. A steering group for the KTH-Sustainability project called the KTH-Sustainability council was also appointed. The council, chaired by the vice-president for Sustainable Development consisted of six teacher representatives appointed by the Faculty Council, and two student representatives appointed by the student union. Teacher representatives were chosen for their personal interest and competence in environment and sustainable development and not as representatives of their schools. Other adjunct members of the council were KTH's Environmental Manager, personnel working at the university administration for KTH-Sustainability and also in some cases faculty representing parts of the university which were considered critical.

The task given to the Vice-president for Sustainable Development was to be responsible for the project KTH-Sustainability and to give advice to the President and the Faculty Council on matters related to environment and sustainable development.

3 Policies, Goals and Strategy

During 2011 KTH developed Vision 2027, an overview of KTH's long-term strategy. Part of the vision is that "KTH is one of Europe's leading research universities in environmental science and sustainable development". Based on the vision the Strategic Plan 2013–2016 was decided in 2012 where it is stated that "KTH's identity and brand are to be associated with sustainable development and KTH will be one of Europe's leading technical universities in this field."

In 2011 KTH began working on implementing an environmental management system. This work was led by the Environmental Manager. According to the President's decision, the system should be ready for certification (ISO 14001) by the end of 2014.

During 2012, KTH established a new environmental policy and environmental objectives for the period 2013–2015 within the following areas: energy, waste, chemicals, transportation, procurement and use of goods and services, education, research and collaboration. KTH-Sustainability's project plan was aligned with the overall environmental objectives for education, research and collaboration.

Environmental Objectives 2013–2015

Education:

- KTH shall work actively to increase teachers' and students' knowledge of and involvement in issues relating to the environment and sustainable development.
- All of KTH's educational programmes should report on how they integrate and develop environment and sustainable development in education in accordance with the Swedish Higher Education Ordinance.

Research:

- KTH's research in the fields of the environment and sustainable development should increase.
- KTH shall conduct research for environmental and sustainable development at a high international level.

Collaboration:

- Increase KTH's visibility and improve collaboration with stakeholders in areas of the environment and sustainable development.

KTH-Sustainability's work is based on a double-track strategy: Integration and Specialisation. Integration is the key. In order to move towards a more sustainable society, sustainability needs to be integrated in education, research, collaboration with industry and society and in administration. However, there is also a need for specialised research in order to provide knowledge that is needed for integration, specialised education and specialised administration.

Activities and projects run by teachers and researchers at KTH's schools have been initiated in four different ways:

(a) once per year there has been an open call for seed money,
(b) spontaneous applications from people asking KTH-Sustainability to support an activity or a project,
(c) KTH-Sustainability has identified a need and initiated a call for applications from interested people who could work with this specific activity,
(d) KTH-Sustainability has identified a need and also a person or a group who could do the work.

Seed money has been awarded to a variety of activities and projects within education (both undergraduate and postgraduate), research and collaboration. The strategy has been to support many activities and projects and to create links between researchers and teachers from different schools and to stimulate collaborative initiatives. Typically the grants have been small (around 10,000 Euros) but occasionally larger. Overall, approximately a third of the applications have been funded. All 10 KTH schools have received funding from KTH-Sustainability during the years, some more than others.

4 Activities in Education

In 2011, KTH performed a self-initiated Education Assessment Exercise (KTH 2012), during which external experts were invited and reviewed KTH's educational programs. Six out of eight panel reports concluded that more efforts were needed in order to integrate sustainable development in the educational programs. There are programs at KTH that have a specific focus on sustainable development, but many other programs lacked the integration. KTH-Sustainability has therefore prioritised integration of sustainable development in all educational programs, and especially in the five year engineering programs (Bachelor plus Master), the three year engineering programs (Bachelor) and the five year Architecture program (Bachelor plus Master).

In 2012, a project on "Integration of Environment and Sustainable Development in the Educational Programs at KTH" was initiated by KTH-Sustainability and a project leader was assigned part time (50 %). This project is still ongoing. It has resulted in several activities within education on the First and Second Cycle. In order to assure the continuous work with integration of sustainability in all educational programs at KTH, KTH-Sustainability has focused on two complementary strategies: evaluation of the program's work and providing tools and support for Program directors and teaching staff to achieve the program goals and the overall learning outcomes in the Swedish Higher Education Ordinance. The evaluation process has been developed in the following order:

2012—All programs submitted self-assessments on the fulfilment of the goals related to sustainable development.
2013—Dialogues were conducted between KTH-Sustainability and deans and directors of First and Second Cycle Education at all the schools. This resulted in development of action programs for integration of sustainable development in educational programs at each of the schools.
2014—All schools were working on fulfilment of the goals set in the action programs.
2015—A follow-up was conducted, which included new dialogues with the program directors at all schools.

The strategy of KTH-Sustainability has been clear from the start. The goal is that all educational programs should integrate sustainable development in line with the Swedish Higher Education Ordinance. The decision on the best way of implementation was assigned to the schools and program directors to assure the relevance for the specific programs, subjects and students. KTH-Sustainability provides support, but the programs must decide on the specific actions. Therefore, KTH-Sustainability has been careful not to prescribe any specific solutions for example in terms of specific courses. This has resulted in different solutions being developed at different schools and also a learning process for all involved. This is also similar to the approach used at for example University of British Columbia where it is recognised that approaches developed for sustainability education should have a flexible, adaptable character to ensure relevance in a variety of settings (Marcus et al. 2015).

The Swedish Higher Education Ordinance has prescribed a number of overall learning outcomes for engineering and architecture educational programs including two with clear relevance for environment and sustainable development. These outcomes are sometimes seen as rather general and difficult to interpret for practical use. In 2011 KTH-Sustainability therefore started a process in which the two general outcomes were further defined into more specified learning outcomes. It was suggested that these could be used for development of programs and courses and also as tools for evaluations. The learning outcomes have been developed in an iterative process including discussions at various workshops, with program directors and the faculty council as well as at international conferences (Finnveden and Strömberg 2013). They have now been adopted by the Faculty Council as advisory. The learning outcomes can to some extent be compared with the sustainability attributes defined by Marcus et al. (2015) and sustainability competencies described by Wiek et al. (2011).

During 2012, KTH-Sustainability mapped all educational programmes and courses to find those with relevance for sustainable development, which was then presented at the KTH website. Criteria for programmes to be on the list are that the programme name should include any of the words environment or sustainability, and for courses at least one of the learning outcomes must address environment, environmental technology and/or sustainable development. Also a "tag" for environment and sustainable development courses in the course and programme directory was developed which made it possible to tag courses and search for these courses specifically. Course responsible teachers can now choose to tag their courses which will then automatically be placed on the list. The list is reviewed by KTH-Sustainability yearly to assure that the listed courses meet the criteria.

The Program directors and teaching staff involved in course design have continuously been able to contact KTH-Sustainability regarding any ideas or need of support for introducing or integration of sustainable development in their curriculum. The support has been given through a "coaching" approach, and by providing contact information on teacher resources and expertise available at KTH that could facilitate the relevant approach for that specific course or programme.

The targeted integration of environment and sustainable development on the course and program levels requires further education of the teaching staff. A new pedagogical course for university teachers has therefore been developed; "Learning for Sustainable Development (4.5 ECTS)". The aim of the course is that teaching staff, based on their own subject, should be able to integrate questions on sustainable development in their teaching so that the students, during and after their education have integrated knowledge and reflections in the subject sustainable development. The course is now included in the cluster of the pedagogical courses offered at KTH.

An online toolbox for integration of sustainable development in higher education was developed and launched in 2013. The toolbox is an open website, published at the KTH homepage. The toolbox aims to be a source of inspiration and guidance for the teaching staff (as well as students) who would like to work more actively with these issues. The toolbox has received attention also from other Swedish universities that are developing strategies for integration of sustainable development in the educational programs.

Through seed-funding, KTH-Sustainability has also supported research on education for sustainable development and participation at conferences. Also seminars, network meetings and larger conferences have been organised to discuss education for sustainable development. KTH-Sustainability's support towards students has focused mainly on financial support of student organisations and in organising various meetings with focus on sustainability.

KTH-Sustainability has been involved in development/support of three course modules (approx. 1.5 ECTS) that can be implemented in several educational programmes at KTH, either as they are or after modifications. A course module focusing on sustainable business development was developed in collaboration with a technical consultant company (ÅF). A course module focusing on social sustainability was developed consisting of two parts: a generic part that could be included in any programme and a more subject specific part, which can be adapted for a specific programme/course. A course module "Introduction to Sustainable Development" was developed (Dahlin et al. 2013) and is now implemented in several engineering programmes at KTH. In contrast to the other modules, this module was developed largely independent of KTH-Sustainability. Several innovative teaching activities are integrated into the module, such as interactive large theatre lecturing (with teacher moderated student debate for up to 180 students at the time) and the use of board games (which includes preparatory quiz questions and peer-discussion). A new text book was launched that supports the content and learning activities in the module. The module is adjusted to each programme and is integrated in different ways in collaboration with the course responsible teachers. All of the modules have now been implemented at several educational programs at KTH.

5 Activities in Research and Doctoral Studies

For research, the activities have mainly focused on building networks, creating meeting places, spreading information and through seed funding to support new initiatives. For PhD studies, the activities have mainly focused on developing courses, supporting courses, compiling information and providing networks.

Network meetings and seminars have been arranged in order to allow researchers from different disciplines to meet and exchange ideas. Some of these meetings have been organised to provide information and promote networking about relevant upcoming calls. Others have been more traditional scientific seminars with internal and external speakers on relevant topics. KTH-Sustainability also supports a number of networking projects and events arranged by others through seed funding. This also includes support of larger international conferences on sustainability related topics organised by KTH researchers.

A newsletter including information about new research calls within the sustainability field is compiled and sent out to KTH researchers approximately every second week.

KTH-Sustainability has supported PhD students in creating a PhD Forum for Sustainability—an arena for students from different schools within KTH to meet and discuss sustainability issues from different perspectives. The Stockholm PhD Student Dialogue on Sustainability was organized in 2013 by PhD students at KTH together with KTH-Sustainability as a means to increase and strengthen research collaboration across disciplinary and institutional boundaries. PhD students from five universities in the region were invited to participate. In 2014 and 2015, similar events were organised at other universities in Stockholm.

An inventory of PhD courses in the area of environment and sustainable development has been compiled and is regularly updated. The aim is to create an overview of courses in the sustainability field and also provide a basis for further development of course offerings.

KTH-Sustainability has also supported several PhD courses including: Sustainability Science, a course module in Social Sustainability, Practice Theory for Design, Planning and Policy Making for Sustainable Lifestyles, Resource Effectiveness coupled to Eco-design, and Communicating Research outside the Academy. The ideas for courses have come from both teachers and students.

In addition to the network projects described above, KTH-Sustainability has also provided seed funding for several research projects, mainly pre-studies. Examples include projects on ship-bottom paints, ocean-current energy harvesting, energy savings in new transport technologies, energy saving in buildings on KTH campus and a photobioreactor for biofuel production from cyanobacteria.

6 Activities in Collaboration

Internal and external collaboration is central to the work on the environment and sustainable development. Strategic external communication is essential for KTH to build its brand in association with sustainable development. In addition, communication helps KTH to create important relationships with key actors, such as the industry. A number of actions and activities have taken place in order to stimulate collaboration both within KTH and between KTH and the surrounding community within the field of sustainable development.

A communication plan was developed in 2012 together with KTH's central communication department and has been updated every year. The overall aim is to: strengthen the association of KTH's identity and brand with the environment and sustainable development, increase collaboration among researchers within KTH, increase the visibility of KTH's sustainability research to the surrounding community and increase the knowledge about KTH's comprehensive education on environmental and sustainability issues at all educational levels. The main external target groups include, decision makers, authorities, politicians, research councils, industry and journalists. The main internal target groups are teachers, researchers, students, management and deans at the schools.

An internal newsletter with general information about upcoming sustainability activities and news at KTH started in spring 2012. This newsletter is distributed via email approximately once per month. An external newsletter targeting the industry, policy makers, government agencies and organizations has also been created. It is distributed approximately six times per year via email. The content of the newsletter is mainly composed of sustainability related news generated by the central communications department (editorials, interviews, press releases etc.). The external newsletter also includes information about upcoming conferences and seminars, new publications and job opportunities in the sustainability field at KTH and more.

KTH-Sustainability Research Day started in 2011 and has become a yearly event in the autumn. The first two years events were primarily oriented towards internal collaboration within KTH. However, for the past three years the event has opened to include both internal and external actors. The event is a showcase for KTH-researchers who present and discuss high interest research findings and technical innovations within the field of sustainable development.

At the end of 2013 initiatives were taken to strengthen and expand the collaborations between KTH and two research institutes, IVL Swedish Environmental Research Institute, and SEI (Stockholm Environment Institute). A memorandum of understanding was signed between KTH and each of the partners and a document with goals for each partnership was developed. These partnerships are expected to facilitate and strengthen long term collaboration. The goals are concrete and concern for example common projects and affiliated faculty. The goals are followed up yearly with a meeting on highest level. Several internal and external seminars have also been created to support the collaboration and show-case joint projects.

Akademiska Hus is the landlord for most of the buildings that KTH use and is thus a key stakeholder in the sustainability work. KTH and Akademiska Hus signed a Memorandum of Understanding in 2014 with the aim of developing the collaboration within the area of environment and sustainability. The goal is to stimulate interaction both at the management and operational level in research, education and innovation, and to further strengthen sustainability research. This collaboration is also followed up on a yearly basis.

KTH became a member of the International Sustainable Campus Network (ISCN) in 2010 and has compiled an annual report about our activities for the ISCN since 2012. KTH became a co-host of ISCN in 2016. NSCN (Nordic Sustainable Campus Network), the Nordic sister group to ISCN, was established in 2012 and KTH has been active in the network since 2013. In 2014, KTH became a member of the steering group of NSCN. KTH is also active in networks for environmental managers at Swedish universities where issues related to KTH-Sustainability are discussed. There are also direct contacts and meetings with Swedish and international universities.

A number of other activities to increase the visibility of KTH's sustainability research and education have been conducted. One example is Stormvarning, an initiative to raise the climate issue in the public debate through cooperation between musicians, scientists and communicators (www.stromvarning.org). This is done by organising concerts and other activities, also involving KTH researchers, where climate change is discussed. One of the initiators of Stormvarning is a PhD student at KTH and KTH-Sustainability has supported this initiative.

7 Results, Indicators, Rankings and Evaluations

A number of activities are ongoing at the schools in relation to education. Courses are being developed and programs are being redesigned aiming at a further integration of sustainability. The level of activity is different at different schools as well as the starting point for different programs. Preliminary results from the ongoing follow-up show that there has been significant progress for many of the programs, but also that there is more to be done.

As shown in Fig. 1 the number of environment and sustainable development tagged courses have increased. The number of educational programs classified as Sustainability programs have been constant during the period. There are currently 11 Masters programmes and one Bachelor plus Masters program focused on sustainability.

A survey to KTH alumni with a few years of experience that is done every third year shows that more than 70 % of KTH alumni in their early career have jobs where sustainability issues need to be addressed. Around 40 % of the alumni responded that they did not receive an adequate education to handle these issues. Obviously these results are linked to the education some years ago, so it will be interesting to follow its development.

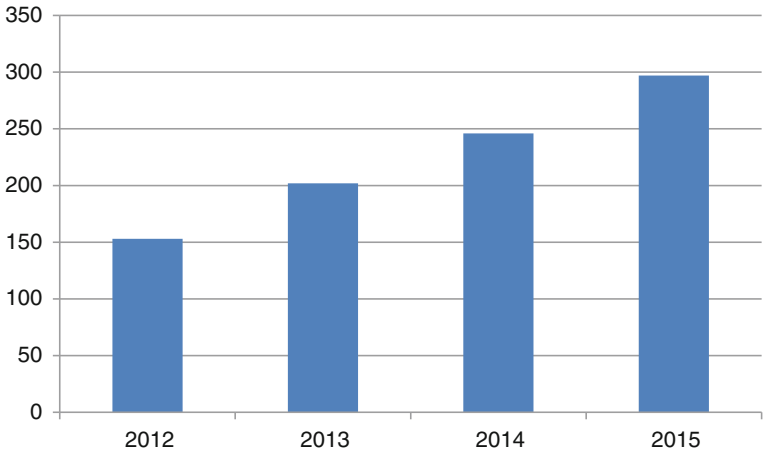


Fig. 1 Number of courses tagged as environment and sustainable development courses, tagging started in 2012

There are several research funding bodies that support sustainability research. Developing indicators for external funding of sustainability research is therefore not straightforward. As an indicator we present data for four research funding bodies supporting research in the sustainability field not claiming that this represent all externally funded sustainability research. The funding from these bodies has increased over the years from 122 MSEK in 2010 to 201 MSEK in 2015 (Fig. 2).

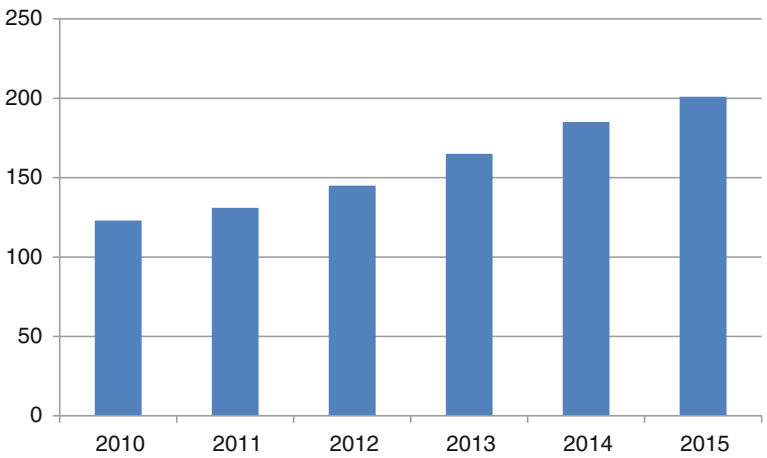


Fig. 2 Funding to KTH from four research councils supporting research in the sustainability field (Formas, Mistra, Swedish Energy Agency and Swedish Environmental Protection Agency) (MSEK)

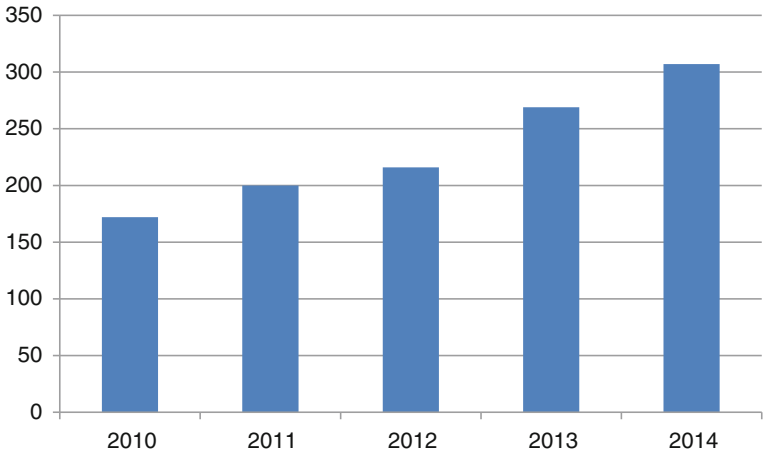


Fig. 3 Number of peer reviewed articles based on a search with 426 terms within sustainable development

Also the share of the KTH's total external funding from these funding organisations have increased from 10.2 to 12.2 % in 2015.

Sustainability-relevant research is published in many fields. It is therefore not straightforward to develop indicators for publications. We have together with KTH's bibliometric specialists developed indicators in this field based on 426 keywords. This list is based on two sources. One is the list used by University of Gothenburg and the second is based on a bibliometric analysis done in order to map KTH's sustainability research. The numbers in Fig. 3 should therefore be seen as indicators. Also the share of KTH's peer reviewed articles have increased from 8.9 % in 2010 to 11.4 % in 2014.

The number of citations is measured with a time lag. The latest data are from papers published in 2012 measuring citations during 2012–2014. This number has increased compared to papers published 2008. The field normalized citations are measured with the same time span and was 1.19 for papers published in 2011 which is down from 1.35 for papers published in 2008. The share of publications of the 10 % most cited is 13 % (2011–2013) and the share of publications that have been published in journals which are among the 20 % most cited is 31 % (2012–2014).

The number of faculty with sustainability or a similar term in their subject has only changed a little between 2012 (34) and 2015 (37). The total number (37) of faculty corresponds to 4.5 % of the total faculty.

During 2014, a survey was made to all departments asking how much of their research that is sustainability-based. The answers were given in ranges (0–20 %, 20–40 %, etc.). The result was that the share of sustainability-based research at KTH is between 19 and 39 % with an average of 29 %.

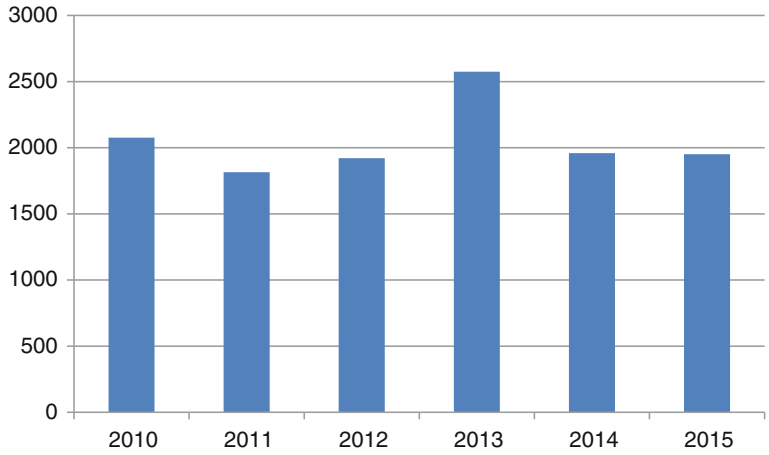


Fig. 4 Hit rate for KTH+ sustainable development (based on 100 terms) in media (newspapers, webpages etc.)

Visibility in media is measured through searches in Meltwater News analysis tool using a list of 100 key words. The list is a short (and Swedish) version of the 426 key words used for the scientific publications. The number of hits is presented in Fig. 4. The results does not show any clear tendency.

The external newsletter was introduced in 2013 and the number of subscribers is increasing. The three last KTH-Sustainability Research Days have had over 300 registrations with a majority being external participants from business, organisations and other universities. Feedback received through evaluation forms has been generally very positive.

There are no widely accepted international ranking lists related to sustainability. Some of them include "environmental science" as a subject. This covers only a part of the sustainability area, but is still of relevance. KTH's position on the QS ranking list has improved between 2011 and 2015 from not ranked (>200) to 101–150.

The Swedish EPA ranks Swedish governmental agencies in relation to their work with environmental management systems. On this ranking list, KTH has increased significantly from a low position in 2012 to the highest position in 2015.

The development of indicators is an area in itself which also needs further development and increased harmonisation would be useful.

During 2015, KTH's environmental management system was after an external audit certified according to ISO 14001. Also in 2015 KTH won the ISCN Excellence in Campus Award for the Campus Plan developed together with Akademiska Hus.

During 2015 an evaluation of the KTH-Sustainability was performed in several steps including a self-evaluation, an interview study with internal and external stakeholders, and an evaluation by three national and international experts (Holmberg et al. 2015). Some of the overall conclusions were that KTH had made significant progress in several areas, that KTH-Sustainability has played an important role, that there is a strong support for the goal that KTH should be a

leading university and that the special initiatives therefore should continue. Based on these results, the President of KTH decided to continue the initiatives started in 2011. Also decisions were taken on a new policy for sustainable development and new sustainable development goals for the period 2016–2020. Based on the evaluations, the organization was slightly changed so that Sustainability Campus and KTH-Sustainability was merged into a Sustainability Office.

8 Discussion—What Factors Have Been Important?

The general conclusion from the evaluation in 2015 was that significant progress have been made, but also that further improvements can be made and there is a need for a long-term commitment. One important factor in the development has been the clear signal from the President of KTH that sustainability is important for both the core activities (education, research and collaboration) and management of KTH. By starting the initiatives, allocating funding and appointing a Vice-president for Sustainable Development and an Environmental Manager, a strong statement from the top management was made. This has been followed up by writings in KTH's Vision 2027, the Strategic Plan 2013–16, the decision that the environmental management system should be certified according to ISO 14001 etc. This is to a large extent in line with recommendations by Lozano et al. (2015).

For education we believe that progress in integration of sustainability in all of the educational programs has been achieved and will proceed. Several programs have developed plans for continuous integration and correlation with the subject areas, other programs have developed specific courses on sustainable development. The process with evaluations has created a momentum and the support of different tools has been valuable. One example is the pedagogical course that has created change in the teaching approach and inspired various actions. Several initiatives have been started at different schools without the direct involvement of KTH-Sustainability. We believe that this at least to some extent is a result of the increased focus on integration of sustainability in education that KTH-Sustainability has been promoting. The development of the action plans at each school is one of the examples that would not have happened without the involvement of KTH-Sustainability. The strategy has not been to prescribe compulsory courses on sustainable development, as for example at other universities (Holmberg et al. 2012), but to leave the decisions on how to integrate sustainable development to the program directors. This is partly as a result of earlier experiences at KTH where the introduction of a compulsory course for all engineering programmes led to a backlash.

For research, several of the indicators show a good progress, for example the number of publications and research funding. It is interesting to note that KTH has climbed on the QS ranking for Environmental Sciences. This indicates that changes are occurring which can be attributed to internal factors. We have not conducted a systematic evaluation of the impact of KTH-Sustainability on research and in many cases it would be too early to see any impact. We know however that the seed

money and networking activities have in some cases led to larger projects. We also believe that in cases where projects have not been successful in getting funding, the activities might have been useful in creating new contacts and cross-disciplinary learning. Already the possibility to apply for seed-funding may therefore be useful.

The organisational structure has in many ways been useful. KTH chose to organise sustainability work within KTH-Sustainability and Sustainable Campus. The basis for the division is that activities related to education, research and collaboration need to be led by academic staff, whereas the environmental management system needs to be implemented in the university administration. The links are however important. Education, research and collaboration also need to be included in the environmental management system and in order to be credible in sustainability-related education, research and collaboration, KTH needs to have a well-functioning environmental management. The Vice President for Sustainable Development and the Environmental Manager can also support each other in their different roles and contacts.

The global sustainability challenges are enormous. Sustainability will be a major driving force for technological development for many decades to come. Our students and researchers will during the course of their careers meet new challenges that they must be prepared to address.

The external evaluation panel and their report (Holmberg et al. 2015) provided useful comments and suggestions. This helped top management to decide on the continuation of the initiatives. Their recommendations also gave perspective and influenced the project plan for the next period. The panel recommended a shift from communication to engagement and towards more student involvement (Holmberg et al. 2015). Stakeholder participation is critical and can take many forms (c.f. Disterheft et al. 2015). During 2015 several new initiatives have been developed at KTH. One is the Dome of Visions (www.domeofvisions.se) which is a meeting place for culture and discussions on a sustainable future developed in cooperation between KTH and a construction company. Another example is several seminars and an exhibition arranged together with Engineers without Borders' student chapter at KTH. Stakeholder engagement can however be resource intensive and sometimes it will only reach a limited number of involved people. It has therefore to be balanced towards other activities and the possibilities to reach many. The panel also suggested that KTH Campus should be used more as a living lab. This is now integrated as one of KTH's sustainability targets for the period 2016–2020. Compared to many other universities the situation at KTH is however complicated by the fact that KTH does not own the buildings and the land and therefore has to do all activities together with a larger number of stakeholders.

The panel also recommended a shift in focus and operation from evaluation to dialogue (Holmberg et al. 2015). This recommendation came partly as a surprise to us, since we did not perceive ourselves as that much focused on evaluation. Apparently the perception from some of the stakeholders was different. We also believe that the evaluative work related to education has been instrumental for pushing the agenda at several of the schools, although it may be too early to draw such conclusions since development of curricula are inherently slow processes.

A threat to sustainability work at universities is that sustainability is seen as a trend, something that is in focus for a couple of years. The history of KTH is full of sustainability initiatives that have made positive changes but have been left behind. KTH needs to continue the long term commitment in line with the ambitions in Vision 2027. The strategy must be to ensure that progress that is made is secured and that KTH builds "institutions" that last. Examples of "institutions" are organizational structures, faculty positions, educational programs and rules for decision-making and normative change. These things take time. Also the Environmental Management System and the ISO certification work as institutions. They provide processes including external audits which make the systematic environmental work necessary. The updated sustainability goals for the period 2016–2020 will be continuously evaluated as a part of the environmental management system, keeping the topics on the agenda. The sustainability goals are in many ways ambitious and comprehensive. They cover education, research and collaboration as well as campus activities, travelling, procurement, financial and management aspects of the university.

This paper describes the development at KTH during the period 2011–2015. It provides an example of activities in several different areas, It shows that progress can be made in a comparatively short period but that a long term commitment is needed. The paper also largely confirms the recommendations by Lozano et al. (2015) that top management need to make a long term commitment, that sustainable development needs to be integrated in policies and plans, that it needs to be acknowledged that the university is comprised of several different elements including education, research, collaboration, campus operations and organisation, that both short and long-term plans for institutionalisation of sustainable development at the university need to be established and that it needs to be ensured that sustainable development is implemented across the university.

References

Dahlin, J. -E., Larsson, P., & Erlich, C. (2013, September 22–25). The use of board games in the engineering education for the purpose of stimulating peer participation in lecture theatre discussions. In *Proceedings of Engineering Education for Sustainable Development*. Cambridge, UK: Cambridge University.

Disterheft, A., Caeiro, S., Azeiteiro, U. M., & Filho, W. L. (2015). Sustainable universities: A study of critical success factors for participatory approaches. *Journal of Cleaner Production*, *106*, 11–21.

Finnveden, G., & Strömberg, E. (2013, September 22–25). Developing sustainability learning outcomes for engineering. In *Proceedings of Engineering Education for Sustainable Development*, Cambridge, UK: Cambridge University.

Holmberg, J., Lindbäck, C., & Robinson, J. (2015). *Evaluation of KTH sustainability: Report from the external evaluation panel*. Stockholm: KTH.

Holmberg, J., Lundqvist, U., Svanström, M., & Arehag, M. (2012). The university and transformations towards sustainability. The strategy used at Chalmers University of Technology. *International Journal of Sustainability in Higher Education, 13*, 219–231.

KTH. (2010). Revision av policy och handlingsplan för miljö och hållbar utveckling. Rapport 101117 (in Swedish).
KTH. (2012). Education Assessment Exercise (EAE) 2011. Evaluation for quality development at KTH—A project summary.
Lozano, R., Ceulemans, K., Alonso-Almeida, M., Huisingh, D., Lozano, R., Waas, T., et al. (2015). A review of commitment and implementation of sustainable development in higher education: results from a world-wide survey. *Journal of Cleaner Production*, *108*(part A), 1–18.
Marcus, J., Coops, N. C., Ellis, S., & Robinson, J. (2015). Embedding sustainability learning pathways across the university. *Current Opinions in Environmental Sustainability, 16*, 7–13.
Ramos, T. B., Caeiro, S., van Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2015). Experiences from the implementation of sustainable development in higher education institutions: Environmental management for sustainable universities. *Journal of Cleaner Production, 106*, 3–10.
UN. (2015). Transforming our world. The 2030 agenda for sustainable development. United Nations.
Wiek, A., Withycombe, L., & Redman, C. H. (2011). Key competencies in sustainability: A reference framework for academic program development. *Sustainability Science, 6*, 203–218.

Author Biographies

Professor Göran Finnveden is Vice-president for sustainable development at KTH Royal Institute of Technology. In that role he is responsible for the integration of sustainable development in education, research and collaboration across the university. His research is mainly focused on sustainability assessments of products, policies, plans and systems. He is a member of the Swedish Government's Scientific Council for Sustainable Development, a member of the board of the International Sustainable Campus Network, a member of the scientific advisory board of the Joint Program Initiative Urban Europe and a member of the editorial boards (or equivalent) of four scientific journals.

Erica-Dawn Egan works with Communications and Outreach at KTH Sustainability Office at KTH Royal Institute of Technology in Stockholm, Sweden. She received a BA in Media and Communications from Södertörn University, Sweden in 2003. She has worked as Information and Marketing Manager before returning to complete a M.Sc. in Environmental Sciences at Södertörn University (2013) where she specialized in environmental policy and communications.

Teresia Sandberg received a M.Sc. Eng. in Chemistry and Chemical Engineering from KTH Royal Institute of Technology, Sweden, in 2011. Since graduation she continued to work at KTH as project coordinator for the internal Education Assessment Exercise, and later with KTH's strategic environmental and sustainability work. She worked as a Project Leader at KTH Sustainability Office, working with integration of sustainable development in education, research and outreach. Her present address is SÖRAB.

Associate professor Emma Strömberg works with Integration of Sustainable Development in Educational Programs at KTH Sustainability Office at KTH Royal Institute of Technology in Stockholm, Sweden. She received a M.Sc. in Chemistry and Chemical Engineering from KTH Royal Institute of Technology, Sweden, in 2006, PhD degree in Polymer technology in 2009 and is since September 2015 an Associate professor in Polymeric Materials at the Department of Fibre and Polymer Technology at the School of Chemical Science and Engineering at KTH Royal Institute of Technology.

Divestment and Investment: Strategic Financial Decisions in Higher Education to Promote Societal Change Toward Sustainability

Jennie C. Stephens, Elizabeth Palchak and Bonnie Reese

Abstract

The aim of this paper is to review the increased use of strategic financial decisions in higher education to promote social change toward sustainability. The social movement to divest from fossil fuels has been growing rapidly, and universities are playing a critical role. New types of university investments to support sustainability transdisciplinary programs and initiatives are also enhancing the societal relevance of many universities. This chapter analyzes the language and themes used to defend university divestment decisions (among both organizations that are committed to divestment as well as organizations that are not committing to divestment) as well as justifications for new investments in sustainability initiatives. The diversity of institutional approaches to using strategic financial decisions to engage with social change represents divergent perspectives on the role of universities in promoting a more sustainable society.

Keywords

Divestment · Investment · Energy · Finances · Universities

J.C. Stephens (✉)
School of Public Policy and Urban Affairs, Northeastern University,
360 Huntington Avenue, Boston, MA 02115, USA
e-mail: j.stephens@northeastern.edu
URL: http://www.jenniecstephens.com

E. Palchak · B. Reese
Rubenstein School of the Environment and Natural Resources,
81 Carrigan Drive, Burlington 05405, VT, USA

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_22

1 Introduction to Divestment, Investment, and Dynamic Role of Universities

Humanity is facing unprecedented challenges associated with climate disruption, fossil fuel dependence, and unsustainable provisioning of food, energy, and water to the growing population (AAAS 2007; McKinsey Global Institute 2011; McKibben 2012). Given the urgency for confronting sustainability challenges, opportunities are emerging for individuals and organizations to engage in new and different ways (Klein 2014). Universities are critical anchor organizations within society offering stability and capacity for long-term thinking and analysis (Hahn 2003; Coalition of Urban Serving Universities 2010). As such higher education has a unique and particularly interesting potential to facilitate societal responses to the sustainability challenges facing the world (Stephens et al. 2008). Strategic financial decisions represent an increasingly important mechanism for higher education to shape a more sustainable society.

The fossil fuel divestment movement has been dubbed the "fastest growing social movement in history" (Brooks 2014). The movement has been developing throughout the past decade with rapid growth since 2012 (Lenferna 2013; Mandery 2014). Within this dynamic social movement, higher education, foundations, private companies, public entities, pension funds, and many individuals are making decisions to move investments out of companies based upon fossil fuel extraction and production. Fossil fuel divestment campaigns are emerging in countries around the world and are particularly visible on college and university campuses. As of early 2016, divestment campaigns are active in over 400 campuses while over 49 colleges and universities have committed to some form of fossil fuel divestment. While 38 are committed to full fossil fuel divestment, others are divesting from coal or both coal and oil tar sands. By linking investments in fossil fuel companies to global climate change, activists have created urgency and momentum, especially within higher education.

Many identify Swarthmore College as the seed of the movement as it was the first institution of higher education to divest in 2011 (Gelles 2015; Grady-Benson and Sarathy 2015). In 2012, the international group 350.org became involved with the fossil fuel divestment movement (350.org 2015), and since then many universities as well as state pension funds, foundations, and individuals have intentionally divested. The divestment movement gained further attention and momentum following a 2012 article in Rolling Stone magazine by Bill McKibben, a scholar in residence at Middlebury College. The high profile piece entitled, "Do the Math", linked the role of fossil fuel corporations to global climate change. McKibben implicated fossil fuel companies writing, "we have met the enemy and they is Shell" (McKibben 2012). The year following the publication of the Rolling Stone article was very active for divestment on college campuses. As the movement grows in size and influence, the discourse and frames justifying individual organizations decisions on whether or not to divest have been evolving.

As fossil-fuel-based energy systems are becoming increasingly destabilized, fossil fuel divestment is not only a proactive progressive step for universities to take, divestment and careful reinvestment in sustainable initiatives, also has huge potential to reduce the vulnerability of universities and enhance their resilience in a rapidly changing world. At the same time that divestment has taken off, universities are increasingly investing in transdisciplinary programs and initiatives focusing on sustainability to enhance the societal relevance of their research and teaching (Martin and Samels 2012; Trencher et al. 2013).

Universities have distinctive organizational cultures that value and promote learning for social good. Higher education, therefore, can play a critical role in processes of societal transformation that are reliant on educating new generations of citizens and leaders. Higher education has always been responsive to societal needs, and the history of higher education demonstrates an evolution of university structure and purpose that reflects directly on the dynamics of society's socio-technical systems (Freeland 1992; Clark 1983; Bursztyn 2008; Vorley 2008). As long-established, often deep-rooted institutions, universities can be slow to respond when societal needs emerge rapidly. Delay between the emergence of a societal impetus for change and the realization of universities' potential contributions to the needed change has been identified throughout centuries of history of higher education (Altbach et al. 1994; Clark 1998). While all organizations respond to and participate in social change, universities as learning organizations represent a specific set of organizations with distinct potential for improving understanding of the interface between organizational change and social change.

Discussions of the role of higher education in society are often characterized by tension among three agendas: generating knowledge, educating citizens and leaders, and addressing pressing social issues (Vorley 2008). It can be argued that all universities transmit powerful educational messages far beyond their specific teaching and research activities (Boyle 2007; Waas and Vergruggen 2008). Concepts of "universities as citizens" (Boyle 2007) and/or "universities as change agents" (Troyer 1974; Stephens et al. 2008) capture the potential for universities to be active, contributing, influential, responsive entities in society. Some suggest that higher education is currently experiencing a swing-back, a return, to an original purpose of cultivating civic responsibility and citizenship via a scholarship of engagement (DiPadova-Stocks 2005; Freeland 1992). Such movement would require institutions of higher education to model civic responsibility and engagement at the organizational level (Boyle 2007), which explicitly incorporates strategic financial decisions and their investment portfolios.

As university engagement in the divestment movement shifts cultural assumptions regarding fossil fuel reliance and as new university investments are strengthening the capacity of many universities to contribute to social change toward sustainability, this chapter reviews this dynamic landscape, highlighting the emerging opportunities for universities to act as change agents, reduce vulnerability and enhance resilience through their strategic financial decisions. This chapter first describes the methods used to analyze divestment and investment. Then the results and discussion of the divestment analysis is presented followed by results and

discussion of sustainability funds in higher education. The chapter concludes by suggesting that the diversity of institutional approaches to using strategic financial decisions to facilitate social change represents divergent perspectives on the role of universities in moving toward sustainability.

2 Methods

The research presented here includes two different sets of analysis. The divestment research includes text analysis of the public statements of 83 colleges and universities that have justified their institutional decision to divest or not. Most of these statements were issued by senior administrators in response to student-run divestment campaigns on campus. Text of the public statements were retrieved from institutions' websites, and the text was coded using HyperRESEARCH text analysis software identifying a set of specific themes developed iteratively by the research team. The research on sustainability investments focuses on a review of different kinds of sustainability funds established in multiple universities.

3 Diversity of Divestment Decisions

As of early 2016, our analysis suggests divestment campaigns have been active in over 400 campuses while over 49 colleges and universities have committed to some form of fossil fuel divestment. While 38 are committed to full fossil fuel divestment, others are divesting from coal and oil tar sands. By linking investments in fossil fuel companies to global climate change, the divestment movement has created urgency and momentum and a very specific financial strategy for having an influence in changing the status quo fossil-based system. This movement has been contributing to the destabilization of the fossil fuel regime, which is a critical component of the renewable energy transition (Geels 2014).

Justifications of universities and colleges that have made public statements regarding divestment span a broad spectrum. Analysis of how different universities are defending their fossil fuel divestment decisions, reveals dynamic communication strategies within higher education with regard to priorities and current perceptions of higher education and its role in changing energy systems (More details available in Palchak and Stephens, forthcoming).

Among the 49 universities that have made formal, public divestment decisions as of December 2015, 38 are committed to full divestment of all kinds of fossil fuel stocks, while 10 have divested only from coal and/or coal and tar sands (Palchak and Stephens, Forthcoming, in preparation). One institution, the Australian National University agreed to divest from seven specific companies engaged in coal and mining activities. Divesting from coal has been particularly resonant with

several large universities as the social, health, and environmental impacts of coal are increasingly acknowledged and the coal industry continues to decline. Thirty-four other institutions have officially stated that they will not divest from any fossil fuel companies. Among those that have committed to divest, justifications include multiple dimensions. One frequent message is that divestment provides an opportunity to align the university's mission and values with the university's financial strategy. Another justification involves demonstrating leadership on climate change action and social justice; divestment is an opportunity to provide leadership on a critical issue facing the world. Divestment activists have effectively framed the movement as a moral imperative, so some universities are also using that frame to justify their decision to divest. Ethical responsibility is frequently mentioned, with a focus on consideration of future generations. Several universities also connect this ethical responsibility with religion and the university's religious responsibility for considering all of humanity.

Among the 24 institutions that have made public statements explaining why they will not divest, most of these focus on their fiduciary responsibility to the organization to maximize the financial gains through their investments (Palchak and Stephens, Forthcoming, in preparation). Nonetheless, financial risks of fossil fuel investing are becoming more widely accepted as the volatility and decline of these stocks has many shareholders concerned about the stranded assets associated with the fossil fuel industry (Ansar et al. 2013).

In 2010 the Securities and Exchanges Commission required that companies report on the vulnerabilities to climate change. Recently this standard has been reaffirmed, setting the context for more transparency and accurate assessments of risks associated with the fossil fuel sector (Securities and Exchanges Commission 2010). This will continue to influence investment decisions. The vulnerability associated with fossil fuel investments has only recently been recognized by some, although some universities that are divesting do connect their decision to divest as a way to be more resilient in the future. Several universities highlight the decision to divest as one of fulfilling fiduciary responsibility by reducing risks associated with the fossil fuel sector. This is a new and important perspective on fiduciary responsibility that connects vulnerability and building resilience through strategic financial decision-making.

4 Investing in Sustainability: Universities and Sustainability Funds

In conjunction with the fossil fuel divestment movement, many universities are simultaneously making strategic investments toward investing in sustainability initiatives of all kinds. In addition to strategic investments in new interdisciplinary programs, curricula, degrees, and research, many universities have set up internal sustainability funds. Designated sustainability funds with specific budgets allocated for sustainability projects have been adopted by over 300 universities in the United

States. These funds are generally designed to provide financial support for a variety of innovative campus sustainability initiatives (Breen 2010).

The structure and goals of sustainability funds at universities varies widely. The Association for the Advancement of Sustainability in Higher Education (AASHE) has categorized these funds into two categories: sustainability revolving loan funds and green funds (AASHE 2016). The primary difference between these two types of funds is fund structure.

Sustainability revolving loan funds need to provide a return on investment and have therefore been mostly focused on efficiency projects. Revolving loan funds provide "dedicated funding for schools to invest in energy efficiency or resource efficiency projects while capturing the cost savings from the reduced energy and/or resource use" (Breen 2010). Revolving loan funds are often used to finance infrastructure improvements on campus. There are a wealth of opportunities for universities to make significant infrastructure changes and reduce their environmental footprint. This fund structure is particularly well suited to this type of investment because the up-front costs can be recouped through efficiency savings. "The number of green revolving funds has more than quadrupled since 2008…… A major incentive is the financial benefit. Our survey found a median annual return on investment of 32 percent" (Wakefield 2012). With this level of financial return, it is not surprising that over eighty universities now have sustainability revolving loan funds. Although these funds have been successful, and significant savings are likely in the early years of a revolving loan fund, use of these funds is vulnerable to decline over time for a variety of reasons related to leadership and participation (Levy and Dilwali 2000).

The other major category, green funds, have been created to support less financially compelling projects. Green funds offer more flexibility and are generally funded through grants, student fees, alumni and administrative budgets (AASHE 2016). Campus green funds provide dedicated "funding of projects such as renewable energy installations, energy retrofits, educational outreach, and the hiring of sustainability personnel occurring on campus and for the benefit of the institution's sustainability efforts."

Our analysis highlights that many universities have recognized that investing in sustainability initiatives is a critical component of their organizational response to sustainability (Weisbord 2011). Designated sustainability funds to support various different types of sustainability initiatives are gaining traction. Categorizations of revolving loan funds and green funds are helpful, although assessing the effectiveness of these different types of sustainability investments is challenging.

An interesting dynamic in universities involves the position of many universities to focus on investment as part of their response and justification for why they will not divest. Many institutions choosing not to divest from fossil fuels are committing to a number of commitments related to new investments, new campus infrastructure, different investing policies and the creation of fossil free funds for donors. For example, Williams College, a prestigious small liberal arts college in Massachusetts with international recognition for their sustainability efforts, made a public statement justifying their decision not to divest from fossil fuels by saying "We will

invest, not divest". Williams also released a commitment to engage five other peer colleges to procure more renewable energy for their campuses. Similarly Harvard University created and announced a new position, a Vice President of Sustainable Investing, in conjunction with its public statement justifying their decision not to divest. Swarthmore College created a fossil free fund for donors and has instructed its investing managers to "describe [the] approach to climate change". Both Tufts University and the University of Vermont created a fossil free fund for donors and Wellesley College developed a Green Revolving Loan Fund for energy investments on campus. Yale University committed $21 million to capital investments in energy conservation over three years and has initiated an experiment on campus with carbon pricing, led by economist William Nordhaus. Middlebury College placed $150,000 under student management to be invested in socially responsible companies and has earmarked $25 million from the endowment to be used for positive investments, targeting companies with high ESG (environmental, social, governance) ratings.

5 Divestment and Investment: Key Components of the Renewable Energy Transition

The fossil fuel divestment movement and the role of universities within that movement, can be situated within the larger renewable energy transition (Brown et al. 2015). The field of socio-technical transitions offers many ways to analyze these complex, multi-scalar changes and continues to evolve as scholars attempt to capture and define the multitude of effects that contribute to complex socio-technical transitions. The multi-level perspective (MLP), refined most recently by Geels (2010) attempts to create a cohesive and reflexive theory of sustainability transitions, allowing for conceptualization of interacting elements shaping various "levels" of an energy transition. Analysis of the divestment movement is an area of work bridging the gap between the niche innovation level and the regime level within the multi-level perspective (Geels 2010). Niche innovations, like the divestment movement, work to dislodge and disrupt current regimes that are unsustainable.

The global divestment movement can be seen as an example of pressure on an entrenched regime as student activists attempt to indirectly affect the power of the fossil fuel industry through investments. This outside pressure and interaction between the various levels of the MLP is essential for system change (Ravetz 2006; Shove and Walker 2010; Geels 2010). Within this context, the value of researching the fossil fuel divestment movement is heightened by several recent papers calling for expanding social science research about the energy transition (Webler and Tuler 2010; Sovacool 2014; Araújo 2014). Specifically, new work calls for a focus on social considerations of energy system change (Miller et al. 2013, 2015; Stephens et al. 2015). In broadening a discussion of energy to more explicitly acknowledge

the role of universities and their financial strategies, this piece situates the divestment and investment movement within the larger energy system transition.

6 Conclusions: Growing Potential Influence of Universities' Strategic Financial Decisions

As the world grapples with questions of resilience, vulnerability, and how to effectively respond to the growing risks of inevitable and ongoing climate changes, consideration of the social impact of universities' investment portfolios and their strategic financial decision-making provides a new opportunity for universities to have influence. The fossil fuel divestment movement within universities has been recently called campus sustainability's "last frontier" (Peterson and Wood 2015). The movement has received considerable attention in major media outlets, also indicating a robust conversation outside of academia about the role of universities in addressing climate change. The Guardian has followed the divestment movement closely, covering many major divestment decisions (Carrington 2015; Goldberg 2015; Tutu 2014). The New York Times has printed several high profile editorials on the topic and The Economist has included several stories on divestment and the valuation of fossil fuels (Mandery 2014; Fleischer 2015; Welch 2014; The Economist 2013, 2015).

The diversity of institutional approaches to using strategic financial decisions to facilitate change represents divergent perspectives on the role of universities in advancing sustainability. Although many universities have now formally committed to addressing climate change and other sustainability challenges facing the world, this research demonstrates that whether and how colleges and universities apply strategic financial-decisions to advance this commitment varies considerably. The broad socially responsible mission of institutions of higher education encompasses new opportunities and challenges for universities as they manage their financial resources and their investments and leverage these resources to increase resilience in rapidly changing markets affected by global change.

This analysis raises a larger set of questions about whether and how higher education can contribute to a progressive agenda and radical social change. In many respects, the stability and tradition of higher education renders colleges and universities as conservative anchor organizations perpetuating prevailing economic and social norms. The overall impact of strategic manipulation of some of their investments is difficult to assess, and could be dismissed as inconsequential toward the more radical progressive change that is likely required to deal with the world's most complex "wicked" problems. But perhaps these forays into financial mechanisms for influencing change will catalyze more challenging conversations and actions in higher education.

References

350.ORG. (2015). *What we do* [Online]. Available http://350.org/about/what-we-do/

AAAS. (2007). *Grand Challenges of Sustainability Science Symposium at the American Association for the Advancement of Science Annual Meeting*, February 17, 2007, San Francisco.

AASHE. (2016). *Association for the advancement of sustainability in higher education*. http://www.aashe.org/resources/green-funds/

Altbach, P. G., Berdahl, R. O., & Gumport, P. J. (1994). *Higher education in American Society*. New York: Prometheus Books.

Ansar, A., Caldecott, B., & Tilbury, J. (2013). *Stranded assets and the fossil fuel divestment campaign: what does divestment mean for the valuation of fossil fuel assets?*. Oxford University: University of Oxford's Smith School of Enterprise and the Environment.

Araújo, K. (2014). The emerging field of energy transitions: progress, challenges, and opportunities. *Energy Research & Social Science, 1*.

Boyle, M. (2007). Learning to neighbor? Service-learning in context. *The Journal of Academic Ethics, 5*, 85–104.

Breen, S. D. (2010). The mixed political blessing of campus sustainability. *PS: Political Science and Politics, 43*, 685–690.

Brooks, L. (2014). Glasgow becomes first university in Europe to divest from fossil fuels. *The Guardian*, October 8.

Brown, L., Larsen, J., Roney, J. M., & Adams, E. E. (2015). *The great transition: Shifting from fossil fuels to solar and wind energy*. New York, Earth Policy Institute: W.W. Norton.

Bursztyn, M. (2008). *Sustainability science and the university: Towards interdisciplinarity*. Working paper for center for international development at Harvard University, No. 24.

Carrington, D. (2015). Fossil fuel firms risk wasting billions by ignoring climate change, says IAE. *The Guardian*, July 9, 2015.

Clark, B. R. (1983). *The higher education system: Academic organization in cross-national perspective*. Berkeley: University of California Press.

Clark, B. R. (1998). *Creating entrepreneurial universities: Organizational pathways of transformation*. Oxford, New York: Pergamon.

Coalition of Urban Serving Universities. (2010). *Urban universities: Anchors generating prosperity for America's Cities*.

DiPadova-Stocks, L. (2005). Two major concerns about service-learning: What if we don't do it? And what if we do? *Academy of Management Learning and Education, 4*, 345–353.

Fleischer, V. (2015). Stop universities from hoarding money. *New York Times*, August 19.

Freeland, R. (1992). *Academia's golden age: Universities in Massachusetts 1945–1970*. New York: Oxford University Press.

Geels, F. (2010). Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research Policy, 39*, 495–510.

Geels, F. W. (2014). Regime resistance against low-carbon transitions: Introducing politics and power into the multi-level perspective. *Theory, Culture & Society, 31*, 21–40.

Gelles, D. (2015). Fossil fuel divestment harnesses the power of shame. *New York Times*, June 13.

Goldberg, S. (2015). Episcopal church votes to divest from fossil fuels: 'This is a moral issue'. *The Guardian*, July 4.

Grady-Benson, J., & Sarathy, B. (2015). Fossil fuel divestment in US higher education: Student-led organising for climate justice. *Local Environment*.

Hahn, A. (2003). *Colleges and universities as economic anchors: Profile of promising practices*. Baltimore: Annie E. Casey Foundation.

Klein, N. (2014). *This changes everything: Capitalism vs. the climate*.

Lenferna, A. (2013). Betting on climate failure: The economics and economics of fossil fuel divestment. *Resilience.org*.

Levy, J. I., & Dilwali, K. M. (2000). Economic incentives for sustainable resource consumption at a large university—Past performance and future considerations. *International Journal of Sustainability in Higher Education, 1*, 252–266.
Mandery, E. J. (2014). The missing campus climate debate. *New York Times*, November 1, 2014.
Martin, J., & Samels, J. E. (Eds.). (2012). *The sustainable university: green goals and new challenges for higher education leaders*. Baltimore: Johns Hopkins University Press.
McKibben, B. (2012). Global warming's terrifying new math. *Rolling Stone,* August 2, 2012.
Mckinsey Global Institute. (2011). *Resources revolution: Meeting the world's energy, materials, food, and water needs*.
Miller, C. A., Iles, A., & Jones, C. F. (2013). The social dimensions of energy transitions. *Science as Culture, 22*, 135–148.
Miller, C. A., Richter, J., & O'Leary, J. (2015). Socio-energy systems design: A policy framework for energy transitions. *Energy Research & Social Science, 6*, 29–40.
Palchak, E., & Stephens, J. C. (Forthcoming, in preparation). *Fossil fuel divestment: The discourse of a dynamic social movement*.
Peterson, R., & Wood, P. (2015). *Higher education's new fundamentalism*. New York.
Ravetz, J. R. (2006). Post-normal science and the complexity of transitions towards sustainability. *Ecological Complexity, 3*, 275–284.
Securities and Exchanges Commission. (2010). 17 CFR PARTS 211, 231 and 241. Securities and Exchanges Commission.
Shove, E., & Walker, G. (2010). Governing transitions in the sustainability of everyday life. *Research Policy, 39*, 471–476.
Sovacool, B. K. (2014). Energy studies need social science. *Nature, 511*, 529–530.
Stephens, J. C., Hernandez, M. E., Roman, M., Graham, A. C., & Scholz, R. W. (2008). Higher education as a change agent for sustainability in different cultures and contexts. *International Journal of Sustainability in Higher Education, 9*, 317–338.
Stephens, J. C., Wilson, E. J., & Peterson, T. R. (2015). *Smart grid (r)evolution: Electric power struggles.* Cambridge: Cambridge University Press.
The Economist. (2013). Unburnable fuel; Energy firms and climate change. *The Economist.*
The Economist. (2015). Fight the power. *The Economist*, June 27, 2015.
Trencher, G., Yarime, M., Mccormick, K. B., Doll, C. N. H., & Kraines, S. B. (2013). Beyond the third mission: Exploring the emerging university function of co-creation for sustainability. *Science and Public Policy*, 1–29.
Troyer, M. E. (1974). Needed correlative university reforms: In role as change agents: Governance climate and structure. In *Annual Meeting of the American Educational Research Association.* Chicago, Illinois: ERIC.
Tutu, D. (2014). We need an apartheid-style boycott to save the planet *The Guardian*, April 10.
Vorley, T. A. J. N. (2008). (Re)Conceptualising the academy: Institutional development of and beyond the third mission. *Higher Education Management and Policy, 20*.
Waas, T., & Vergruggen, A. (2008). *University research for sustainable development: Characteristics identified. EMSU 2008.* Barcelona, Spain.
Wakefield, J. (2012). *UVM's $13 million commitment to green challenge is country's largest; Surpasses Harvard*. The University of Vermont, August 02, 2012. Web. January 07, 2016. http://www.uvm.edu/newsstories/news/uvm%E2%80%99s_13_million_commitment_green_challenge_countrys_largest_surpasses_harvard
Webler, T., & Tuler, S. P. (2010). Getting the engineering right is not always enough: Researching the human dimensions of the new energy technologies. *Energy Policy, 38*, 2690–2691.
Weisbord, D. (2011). Greening the bottom line: The trend toward green revolving funds on campus. *Sustainable Endowments Institute*. Web accessed January 11, 2016. http://files.eric.ed.gov/fulltext/ED539860.pdf
Welch, I. (2014). Why divestment fails. *New York Times*, May 9.

Author Biographies

Jennie C. Stephens is the Dean's Professor of Sustainability Science and Policy at Northeastern's School of Public Policy and Urban Affairs. Her research, teaching, and community engagement focus on social, political and cultural aspects of the renewable energy transition and strengthening climate resilience. She is a 2015–2016 Leopold Leadership Fellow, and she was previously on the faculty at the University of Vermont (2014–2016), Clark University (2005–2014), and she earned her PhD at Caltech in Environmental Science and Engineering.

Elizabeth Palchak is a graduate student in the Rubenstein School of Environment and Natural Resources at the University of Vermont. As a Graduate Fellow in the Office of Sustainability, she researches and supports the development of recommendations for socially responsible investing at the university. Her dissertation research focuses on the social aspects of renewable energy transitions, specifically the role of higher education and strategies for energy conservation behavior.

Bonnie Reese is a graduate student in the Rubenstein School of Environment and Natural Resources at the University of Vermont. Her research is focused on energy innovation in the university setting. Bonnie has an MBA from Babson College and a BS in Psychology from Trinity College in Hartford, CT.

(Be)Coming and *(Re)Membering* Through Kitchen Based Learning *as* Sustainability: An Innovative Living Learning Systems Model for Higher Education

Joy Kcenia O'Neil

The significant problems we face cannot be solved at the same level of thinking we were at when we created them.
Albert Einstein (1879–1955)

Abstract

Higher education tends to situate sustainability epistemologically as transmissive education *about* and/or transactional education *for* sustainability. Sustainability educators argue that these approaches remain part of the dominant dualist and reductionist way of teaching and learning—a *weak* sustainability. What is needed is a transformative learning process *as* sustainability. Numerous sustainability educators and practitioners propose a *strong* sustainability supported by ecological relationality. In this chapter, I draw from ecological living systems principles (Capra in The hidden connections: a science for sustainable living. Anchor Books, New York, 2004) and relational agential realism (Barad in Differences: A Journal of Feminist Cultural Studies 10: 87–126, 2007) to illustrate an innovative pedagogical approach of the environmental sciences. Calling it kitchen-based learning it uses cooking, eating and sensing as a relational transformative learning process towards *(be)coming* and *(re)membering* social and ecological sustainability. A vision for tomorrow's campus in higher education is to include innovation in pedagogy giving attention to how students learn as a process of educating *as* sustainably.

J.K. O'Neil (✉)
College of Education, Educational Sustainability, University of Wisconsin-Stevens Point, 1901 Fourth Avenue, Stevens Point WI 54481, USA
e-mail: joneil@uwsp.edu

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_23

Keywords
Higher education · Kitchen-based learning · Ecological living systems · Transformative learning *as* sustainability · Environmental science · Relational onto-epistemology · Posthumanist agential realism · Transformative sustainability education

1 Introduction: Environmental Science and Sustainability in Higher Education

As an Environmental Science instructor in higher education for over 10 years, I am hired for my subject matter expertise. Environmental Science covers the basic ecology of ecosystems and the effects and consequences of human activity on ecosystems. These include issues such as human population dynamics, energy and material resources, pollution and environmental health as well as the scientific methodologies for analyzing environmental data. More recently, the term sustainability entered into the Environmental Science textbook. The concept of a sustainable society that is generally used, is consistent with the definition of the World Commission on Environment and Development (1987): a society that meets the current and future basic resource needs for people in a just and equitable manner without compromising the ability for future generations.

I was teaching Environmental Science and sustainability the way I was taught in a classroom setting—rows of tables and chairs; I at the front, an autonomous authority lecturing from my PowerPoint slides. I typically explore environmental dynamics against the backdrop of human influences such as population, global production as well as consumption of natural resources, and social and economic inequities. My responsibility is to meet the conceptual subject matter objectives. However, this kind of pedagogy is situated in the dominant, transmissive modernist paradigm of causality, calculability, 'reconstructibility' and dualism. The way I had been teaching the subject matter leads to a concrete, linear way of knowing, at odds with the content itself.

In response to my teaching, I noticed students talking about "doom and gloom" scenarios, finger pointing the government, and feeling personally disempowered towards meaningful change. Their questions were troubling—'why are they inheriting a damaged earth' and the ubiquitous 'why "we" are not doing something about it'? Most of them complete the course with a passing grade; and I felt successful in transmitting knowledge about Environmental Science and sustainability. It never occurred to me that this pedagogy was part of the same paradigm of thinking that created the environmental issues.

Environmental Science subject matter views reliance on solar energy, biological diversity and chemical cycling as vital for achieving sustainable societies. This led me to question if I should not draw from the very subject matter I teach about in Environmental Science and apply it to *how* I teach and *how* students learn in hopes

to foster social and ecological sustainability, not only in their way of knowing, but also in their way of being. Systems thinker Capra (2004) suggests we do not need to create sustainability from scratch; instead, we need to "model [communities] after nature's ecosystem's" (p. 230). He argues that we need an operationalize sustainability, a *strong sustainability*. A strong sustainability has less faith in traditional capitalist economics and views nature as intrinsic and basic to human survival, espousing a deep ecological view of the world that supports bio-equity of species where humans cannot stand apart from nature (Taylor 2013). Numerous sustainability educators and practitioners (Orr 1992; Lange 2004, 2009, 2012; Sterling 2004, 2010; Jones et al. 2010; O'Sullivan et al. 2002) propose a transformation beyond this modernist and dualist paradigm of thinking into ecological relationalism as part of strong sustainability (Lange 2012; Capra 2004, 2002; Orr 1992; Spretnak 1999).

Moore (2005) states that there is enormous potential for universities and colleges to be leaders in sustainability, "questioning the status quo, challenging paradigms, and openly practicing new ways of living, thinking, teaching, and learning" (p. 78). In the United States, the Association of Advancement of Sustainability in Higher Education (AASHE 2010), has established their mission as "empower[ing] higher education to lead the sustainability transformation" (p. 2). "What is needed is curriculum to prepare learners for living sustainably, both professionally and personally, and that explicitly helps the learner deeply understand the interactions, inter-connections, curriculum, and the consequences of actions and decisions" (p. 2).

That said, higher education often engages the topic of sustainability by incorporating content (e.g. climate change), sustainability concepts (e.g. systems thinking), and methods (e.g. community-based projects) into their teaching. In other words, teaching approaches tend to lean towards educating *about* and education *for* sustainability. This is often described as fostering weak sustainability (Orr 1992). Given that college educators are disciplinary experts, we do not tend to think about the learning experience that occurs in the classroom as part of the course objectives or about a philosophical approach to the teaching and learning process. There is little focus on examining the learning process *as* sustainability.

In (2011), UNESCO's Daniella Tilbury found there is little empirical evidence regarding the sustainability education learning process. In her review of thirteen case studies of exemplary practice, Tilbury suggests that the processes include: (a) collaboration and dialogue; (b) engagement of the whole system; (c) innovative curriculum and; (d) active and participatory learning. In addition, she found that the preferred outcomes in student learning were: (a) asking critical questions; (b) clarifying one's own values; (c) envisioning more positive and sustainable futures; (d) thinking systemically; (e) responding through applied learning; and (f) exploring the dialectic between tradition and innovation. Is it possible the key to achieving these process and outcomes is to turn our attention to what occurs within the classroom dynamics?

Coming from an ecological lens, I asked myself the question, "how do we learn?" I became increasingly conflicted utilizing a linear model of learning that focused solely on cognitive-rational learning objectives. I began to inquire about the interactions between the living and non-living factors in systems and implications for my teaching. At this time, I was teaching a course about sustainable food systems, when it hit me like a crashing wave: "can cooking and eating be a pedagogical innovation in which the class(room) operate as a living learning system? What would this look like for higher education?"

This chapter describes the results of a research project called, kitchen-based learning *as* sustainability (KBL) (O'Neil 2015). This chapter will distinguish education *about, for* and *as* sustainability, then present a theoretical framework for thinking about instructional design in higher education with illustrations for using ecological principles (Capra 2004) to guide learning as a living system. Transformative sustainability education in higher education will be discussed and implications for an ecologically relational approach to designing tomorrow's campus will conclude the chapter.

2 Situating Sustainability in Higher Education

Sustainability in higher education is situated within three paradigms of learning. Sterling (2011) conceptualizes these paradigms by adapting Bateson's (1972) ecological systems theory of mind and Bohm's systems view of thought into a "nested" system of learning. In the center of the nest lies learning (cognitive), followed by meta-learning (meta-cognitive), and epistemic (transformative) learning. Sterling's application of the nested system model to sustainability education can be explained as the first (education *about* sustainability), second (education *for* sustainability), and third order (education *as* sustainability) of change.

3 Education *About* Sustainability

Education *about* sustainability is theoretical or conceptual knowledge discussions about how to meet our needs now and in future generations. Sterling describes this as "content/knowledge bias," which can be taught under the current educational paradigm (2001). This first order of change, can be described as 'doing more of the same', by transmitting knowledge to students. Curricular goals refer to creating awareness of environment, economics and societal issues which are considered to operate independently of each other, with the environment only as backdrop. While subject matter knowledge is clearly important in education, it falls short of actionable solutions and can often be an overwhelming "doom and gloom" way of teaching and learning. This transmissive approach to teaching and learning is built

on a behaviorism and mastery learning focusing on overt behaviors that can be observed and measured, insufficient for sustainability education (Sterling 2004; Capra 2004).

4 Education *for* Sustainability in Higher Education

Education *for* sustainability is a second order of change that focuses on a teaching method or tool to achieve sustainability. It moves from a theoretical discussion about sustainability into action or learning for change. The second order of change questions values and assumptions in order to form new beliefs (an epistemological change). The idea behind this way of teaching is not only to transmit knowledge but to transact a skill and attitude towards sustainability with the intention of personally and societally catalyzing change well after completion of the course. Although contested (Jickling and Wals 2012), this is the dominant paradigm in sustainability in higher education today. This approach can be seen through action-oriented, hands-on, or experiential activities. While it is important to learn sustainability skills such as how to garden or how to organize and engage in a community project, it stops short of a holistic transformation.

5 Education *as* Sustainability

Subsuming the first two paradigms, education *as* sustainability is a transformative learning paradigm that focuses on learning processes as a "creative, reflexive and participative process" (Sterling 2004, p, 61). To make this third level change, Sterling proposes holistic learning as an emergent way of knowing. It involves three facets: *extension* which a perceptual dimension of deeper and wider boundaries contexts in time and space. It recognizes the need for co-dependence and co-determining of present and future. The second facet is *connection* which is the conceptual dimension understanding linkages and patterns in what seem disconnected. Thirdly, it involves *integration* which is the practice seeking healthy relationships, often through an emergent property where the whole is recognized as greater than the sum of parts. Sterling (2011) explains this highest level of change is dependent on mental models in which learners "see things differently." I draw from Sterling and situate this chapter in the proposed third level of learning; I propose not only an epistemological shift is mental model of seeing things differently, I propose an ontological shift in being differently. This being will be expressed as ecological relationalism. Ecological relationalism is a holistic and a responsive approach to the emerging complexity and uncertainty we face on a daily basis.

6 Living Systems Relationality in Learning Sustainability

Transformative sustainability education is not just an epistemological shift in knowing nor does it consider human and nonhuman as discrete objects; rather, it is an ontological shift in living/being and learning. Lange (2012) agrees that it will take an ontological shift to reach this third level of change. Capra (2004) has identified the key ecological principles I adopt as guide to living and learning an ontological ecological relationalism. These principles include: partnership, diversity, networks, cycles, dynamic balance, and development. In other words, not only to know ecological systems and principles; rather, to live and learn these principles through intra-actions with human and non-human matter. Just as Einstein found, "matter does not refer to a fixed substance; rather, matter is substance in its intra-active becoming—not a thing but a doing, a congealing of agency…"matter" refers to phenomena in their ongoing materialization" (Barad 2007, p. 151). This is important because not only are human and nonhuman entangled in an intra-active ecological process, the ecological processes are also entangled to each other unable to be separated.

"Radical relationalism" means that subject-object, mind-body, nature-culture, emotion-cognition, are entangled in a performative "dance"—epistemologically and ontologically "in action." Quantum physicist, Karen Barad uses the term performativity where: "meaning is not a property of individual words or groups of words but an ongoing performance of the world in its differential dance of intelligibility and unintelligibility" (p. 149). Transformative learning is unpredictable, uncertain and complex as Lange (2012) suggests. Therefore, transformative learning *as* sustainability goes beyond an epistemological shift in thinking and into an ontological shift in *(be)coming*. According to Deleuze and Guattari (1987), (*be)coming* is a process of change, flight, or movement.. *(Be)coming* is when one "thing" is drawn into the territory of another, potentially changing its value as an element and bringing about a new unity (p. 278). In the case of KBL, it could be viewed as Michael Pollan proposes in his book, *Cooked: A Natural History of Food Transformations*–as we transform food, food transforms us.

Lange (2012) proposes that existing transformative learning theorizing needs to "shed its modernist clothing" to become transformative sustainability education. This means that the locus of transformation is not only seeing things differently or located in the individual or society as concrete entities or understood in a linear developmental trajectory. Rather, transformation is, "emergent, participatory and inclusive of the conscious and unconscious" (p. 202). Figure 1 depicts an epistemological shift in knowing *about* and *for* sustainability to an ontological shift in learning *as* sustainability. KBL is located in a relational ontological shift of *(be)coming* sustainability.

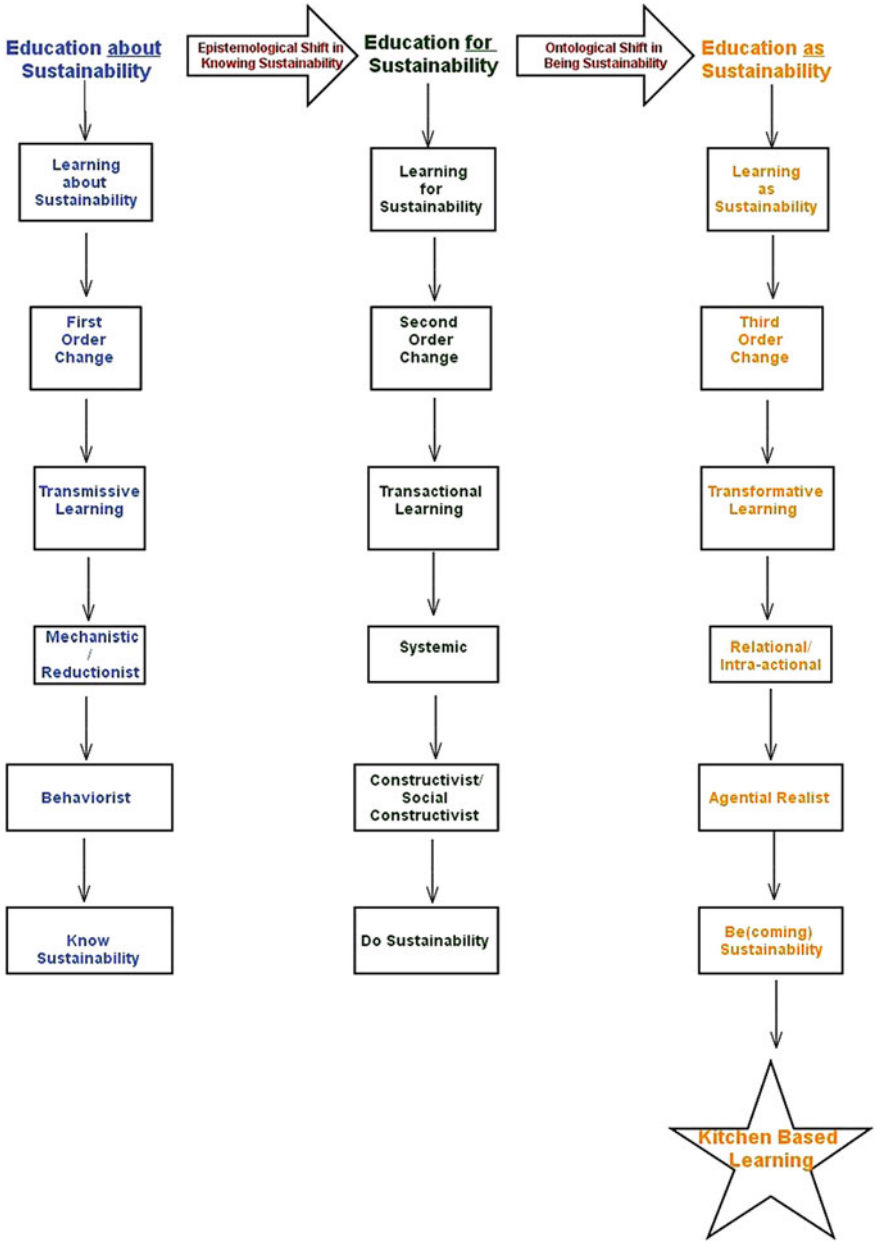


Fig. 1 Epistemological and ontological shifts in sustainability education located in KBL (O'Neil 2015)

7 Discovering Relationality: Kitchen-Based Learning

As I was teaching Sustainable Food Systems with my old paradigm; my students began to question me about what certain foods tasted like. In a spontaneous action, we went to the grocery store. Returning to the college, we spent the remainder of time not in the class(room), but in the kitchen(room). Students cooked, ate, and sat around the table talking about their childhood experiences with food, how they engage with food now, and they were helping each other learn. Subject matter content wrapped into the conversations—no distinction could be delineated between content about and process (of sustainability).

It brought me to think about how in a traditional classroom setting, we tend to view learning as autonomous—separate from instructor, books, pencils, test taking, and note taking—when in fact, they are not independent but rather deeply intra-dependent. After class ended, I questioned what I had just done. This was college not a cooking school; I am a science professor and yet, being in the college kitchen enhanced their learning. Was this acceptable? Students were, "learning to cook" but as importantly they were "cooking to learn (sustainability)." This was the birth of KBL—out of transmission into transformation, and out of the class(room) into the kitchen(room). For the first time, I could conceptualize the theory of transformative education *as* sustainability in which we focus on the processes of learning *as* change.

8 Framework for Instructional Design

I created the KBL framework to explore these ideas through a lab science course called, *Environmental Cooking,* offered at the University of Vermont by an instructor who had developed a cooking pedagogy based on John Dewey's theory of learning (Belliveau 2007). The course subject matter was designed around four dominant perspectives of sustainability: social justice (S), economics (E), environment (E), and diet/health (D) or the SEED model. There were 9 undergraduate students in the course meeting for 5 full 8-h days, preparing and eating both a lunch and dinner menu with each day focused on elements of the SEED model.

Figure 2 is the visual representation of the instructional design cycle for each session. Each session began in the classroom attached by a door to a kitchen filled with eight cooking stations and all the cooking equipment. The first hour was spent in discussion about course content: readings, homework, quizzes, and cooking technique. It is important to understand that there is nothing new about cooking as a means to infuse subject matter such as math lesson on measurement (a dualist paradigm of subject and object), but I was focused and this chapter is focused on the intentionality of the teaching and learning process in which the subject matter was taught (a non-dualist paradigm of subject and object). This is the paradigm of learning *as* sustainability.

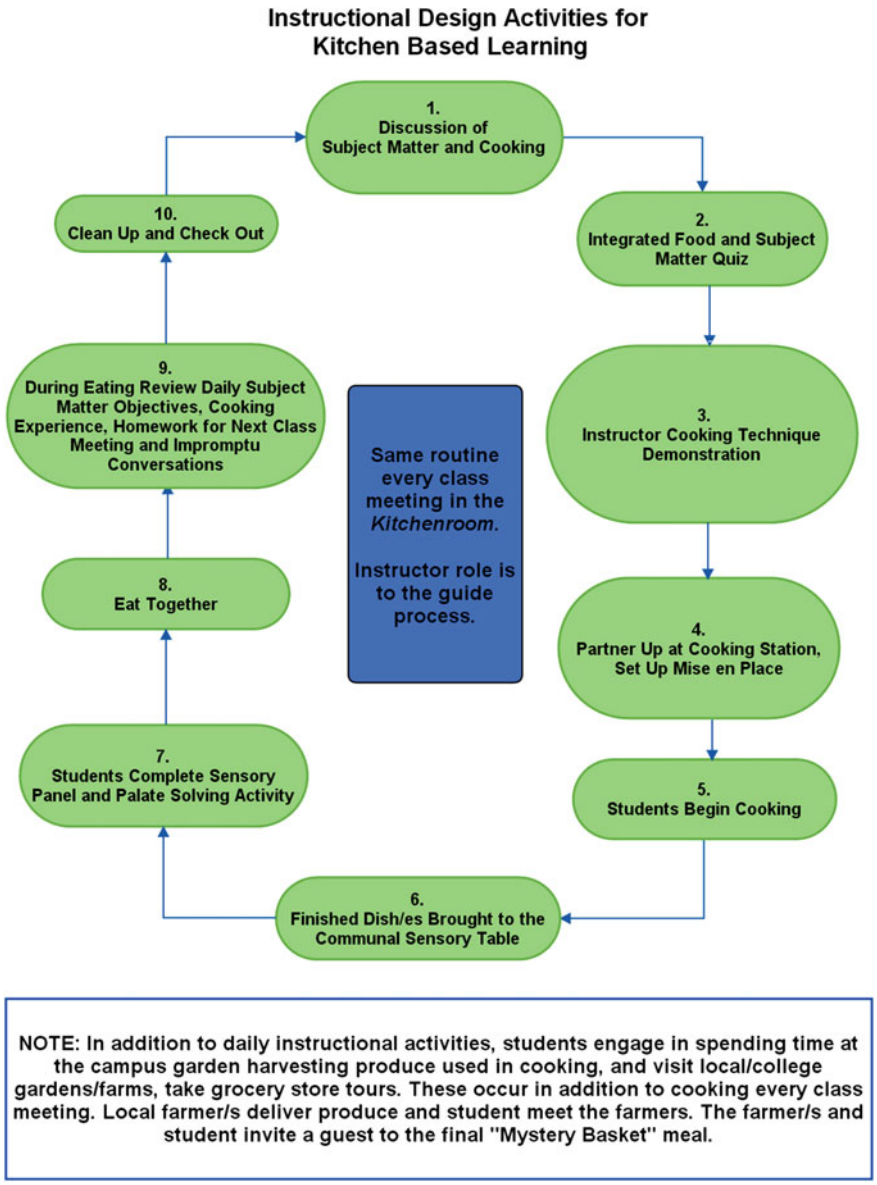


Fig. 2 Visual representation of the instructional design cycle for KBL (O'Neil 2015)

After content related discussion, students moved into the kitchen to watch the demonstration of a culinary technique and prepare for their daily menu and cooking. The instructor used skill level progression and thematically-driven activities. Once they exercised their new skills and knowledge by cooking a meal,

students brought their finished dishes to a communal table. Before students ate, they were required to complete the sensory skill activity as part of their lab report. Students described the smell, taste, texture, and they palate solved. "Palate solving" means describing their own dish, comparing it with another team's dish, much like wine tasting, and then determining changes that could improve the result. Students were then asked to deeply experience their food by connecting to their senses and what memories might be elicited or insights gained. This communal eating time was also spent reinforcing any needed subject matter and cooking concepts before clean-up. The course also included several field trips to grocery stores and to the university farm—also intentional for the learning process.

9 Kitchen-Based Learning: An Innovative Living Learning System

> What we need is a robust account of the materialization of all bodies—'human' and 'nonhuman'—and the material discourse practices by which differential constitutions are marked. (Barad 2003)

The kitchen-based living learning system model was built through a robust literature review in sustainability education, including place-based education, experiential learning, holistic learning and transformative learning theories (Orr 1992; Lange 2004; Heron 1992; Immordino-Yang and Damasio 2007; Lenz-Taguchi 2010) as well as food philosophy and practices (Sutton 2010; Heldke 1992). After I relationally mapped the literature, I applied theoretical lenses of ecological living systems theory (Capra 2004) and relational post-humanist agential realism (Barad 2007).

The conceptualization of agential realism by (Barad 1998, 2007) was formulated by the inspiration of the founding father of quantum physics, Niels Bohr. Physicist Niels Bohr had proposed that the unit of measurement is the phenomena, in this case the convergence of particles and waves, and not the extraction of the particles from the waves. He viewed the human as part of the apparatus as opposed to the human as the knower separate from the apparatus used to measure. Barad takes this further, using Judith Butler and Michel Foucault to develop her concept of relational post-humanist agential realism. Matter or material is both human and non-human. "Matter is a stabilizing and destabilizing processes of iterative intra-activity" (p. 152) meaning that it occurs all within the phenomena. I view food, cooking tools, students, instructor as entangled co-evolving, co-creating material, and the cycle of learning activities (transforming food, eating, sensing, discussion) as iterative stabilizing and destabilizing process of learning.

This goes beyond current interactional ecological thinking in which entities pre-exist the phenomena; in agential realism, ecological relations do not hold a priori agency; rather, they are entangled in the phenomena. Barad calls these "intra-actions" (as opposed to interactions) in which all living and non-living "things" entangled in forming matter and meaning. Additionally, "all bodies, not

merely human bodies, come to matter through the world's iterative intra-activity" (Barad 2007, p. 152). This means that in the kitchen "ecosystem." it is the students, food, tools, teacher and activities etc. that matter together in an entangled phenomena as opposed to humans 'doing to' a material object (cooking). Taking John Dewey's experiential learning or "learning by doing", a step further, it is an iterative intra-active process of "doing in action." In essence, we "perform" learning.

Performing learning situates knowledge as "emergent and participatory" (Lange 2012, p. 209). It has emergent properties because learning is ecologically intra-connected: students go back and forth from the refrigerator, stove, cupboards, talking to one another, with clanking sounds of chopping and cooking, showing each other something special about their cooking method, laughing, silence and

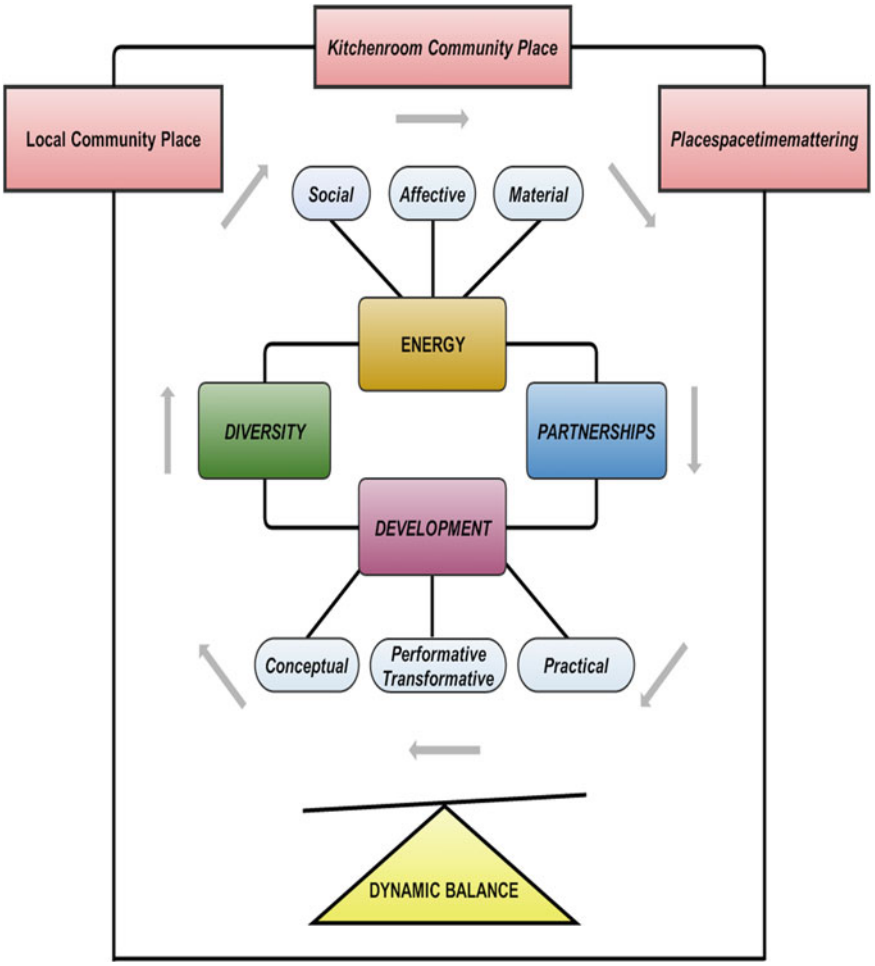


Fig. 3 KBL: a living learning system (O'Neil 2015)

focus. There was quick decision making, students were under stress, emotions were "all over the place" while getting many dishes prepared. Similarly Barad (2003) states, "This is not a static relationality but a doing—the enactment of boundaries…" (p. 803).

In other words, transformative KBL includes human and nonhuman as co-constitutive forces intra-dependent within a living learning framework. Within the KBL instructional design (Fig. 2), I illustrate below how transformative learning *as* sustainability functions with the seven ecological principles of a living learning system (see Fig. 3 for entire living system model). However, I will describe only one of the principles, energy, which is at the core of the learning system. Even though I only describe one principle, it is impossible to explain it in isolation from other ecological principles because learning is intra-connected, emergent and dynamic.

10 Energy: Social, Material and Affective Learning

> Solar energy, transformed into chemical energy by the photosynthesis of green plants, drives the ecological cycles. All living organisms must feed on continual flows of matter and energy from their environment to stay alive, and all living organisms continually produce waste. However, an ecosystem generates no net waste; one species' waste is another species food. Thus, matter cycles continually through the web of life. (Capra 2004)

In an ecosystem, the nutrient cycle is movement and energy exchange (nutrients) of living and non-living matter. A healthy ecosystem is highly dependent on this energy flow. In the living learning system, each student also needs a continual cycle

Table 1 KBL energy flow concepts, intra-connections, processes and outcomes (O'Neil 2015)

Ecological principle	Learning concept	Ecological connections	Learning process	Learning outcomes
Energy flow	Social Affective Material	Connected to all ecological principles, especially to practical, conceptual and performative transformative development	Performative energy: through engagement with exteroceptive and interoceptive senses in an ongoing inclusive, interdependent flow, and entanglement of structures Performative energy co-emerges into new meaning patterns	Empathetic, feeling resonance and felt participation invokes a special memory, appreciation, caring, or emotional bond to a person or place bringing full meaning to consciousness and our full consciousness into our restorative change in relational *(be)coming* and *(re)membering*

of energy flow of social, affective and material learning through performative encounters in the learning activities. It is the instructor's task to build the curriculum in cyclical patterns, thematic curricular units and foster a dynamic balance between subject matter, learning activities and student engagement. Every student goes through the same activities, general conceptual subject matter development and skill acquisition, but what is different is if and how students enter into a performative transformative learning process. This is the unmeasurable aspects of learning that is not fully considered in higher education (Table 1).

In the *Environmental Cooking* course, one example occurred through a "living story" called, *(Be)coming with Carrot.* During the first day, a student told me how her stove in her apartment is covered in papers and how she never cooks even coming from a family that celebrates food culturally. During making Carrot Salad later that day, she closely worked with carrots through peeling and chopping and yet, expressed her aversion to carrots. When we engaged in the sensory panel, she was tasked with deeply sensing the salad and express what it reminds her of. This activity emoted her feelings expressed verbally and written word about how she was forced to eat carrots as a child. In post-humanist ecological relationalism, the carrot is now the co-participant in her transformative learning process. Immordino-Yang and Damasio's (2007) concepts of emotional thought in which emotion and cognition overlap into emotional thought. This emotional and cognitive thought is a performative transformation entangled with human and nonhuman material intra-dependence. This is what was happening to this student.

This ecological energy further cycled to subsequent days leading her to share more stories relating back to carrots and then, family, expressing her relief of breaking free from her close-knit family by coming to study in the U.S. These were deeply entangled in her relations with food, healing, and building classmate relationships through eating together. After sensing, classmates eat communally and she did not gain a relationship with carrots per se, but the carrots were her vehicle to express how it feels like 'family eating together'—rekindling a relationship with her own family. She said that she can teach them sustainably healthy recipes extending her knowledge about the SEED model onto others. This is an example of the type of extension that Sterling proposes. It was an energy flow into her restorative process of *(be)coming* socially and ecologically healthy from her previous lack of connection with food in a foreign land away from her family. On the last day she said how she cleared her stove off of papers and was ready to cook. Supported by Lange's (2012) proposal, the entanglements of structures, processes, and energy did co-emerge into new patterns of restorative healing fostered by a learning sanctuary (Lange 2009). In this case, the learning sanctuary was the kitchen(room). This student went through an ontological way of *(be)coming* and *(re)membering* into social and ecological sustainability; this process was not complete; but an ongoing iterative process that takes time to heal.

Energy connects to all the ecological principles through the entire teaching and learning process and there is no beginning or ending. Empirically tested with kitchen-based pedagogy, I adapted Sterling and Bateson's nested learning model. I call it, "O'Neil's nested learning" (ONL). ONL is not only an epistemic view of

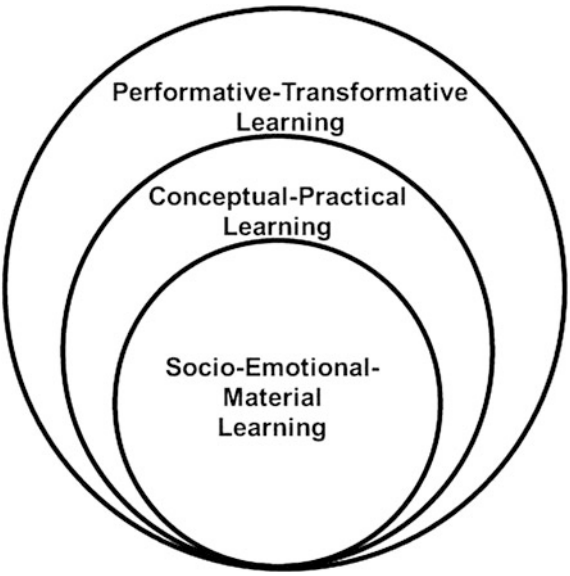


Fig. 4 O'Neil's nested learning *as* sustainability (ONL) (O'Neil 2015)

learning, it is an onto-epistemological learning 'entanglement' (Fig. 4). When Lange (2012) explains the need for transformative learning theory to "inform sustainability education and to help build sustainable communities," she elaborates on Spretnak's (1999) argument that we need to understand human as, "fluid and connected in multiple ways, particularly at the energy level within a vast creative network" (2012). Lange further explains how learning is connected in space and time by a "vast sea of energy" (2012, p. 202). In KBL, the energy is driven by three key ingredients: emotional, social, and material relations. The rudder to this energy field was affective learning (emotions), however; we do not emote alone. Emotions are entangled with social and material "triggers." In other words, emotions are provoked by the learning activities of cooking, sensing and eating with food, classmates and the instructor.

Lange argues that this type of transformation goes beyond an epistemic change in thinking or seeing things differently as Sterling's proposed nested model suggests, "it is also an ontological process where participants experience a change in their being in the world including their forms of relatedness" (Lange 2004, p. 137). In this perspective, students did learn the practical (cooking) and conceptual (SEED subject matter) knowledge, but more importantly to education *as* sustainability, students entered into their own material-discursive performative transformation. In this example, the student and the carrot was only one students' transformative learning process; there were many others. The complexity and reality is when students touch food, food touches students in a performative transformative learning process.

11 Conclusion: Transformative Sustainability Education in Higher Education

In higher education, educators are disciplinary experts; therefore, when teaching tends to fall back on imparting knowledge onto students, in the form of a transmissive educational paradigm or educating *about* sustainability. Transformative sustainability educators (Lange 2004, 2009, 2012; O'Sullivan 1999, 2002; Sterling 2001, 2004) suggest we move into a more conscious relational and interconnected being in the world. This moves educators into education *as* sustainability, focusing on the process and dynamics of learning *as* change. In the interdisciplinary field of sustainability education, there are few models and empirical studies of the learning process *as* sustainability (a learning process for transformative change); therefore, this chapter has described a living learning system for higher education as well as a novel approach, KBL, to achieve transformative sustainability education, a third order change for higher education.

12 Visions for Tomorrow's Campus

The vision for tomorrow's campus is not only to infuse sustainability across campuses and communities into disciplines and across disciplines. It is to relationally *(be)come* sustainability though our intra-actions. This deep way of being goes beyond an epistemological shift in knowing the world and into an ontological shift of *(be)coming* of the world. This is not simply knowing about subject matter such as environmental science; it is performing environmental science (the tenets of ecology) in the process of learning. While subject matter outcomes do not change, transformative learning occurs. This leaves some uncertainty for higher educators as poststructuralist ways of learning do not necessarily yield quantifiable change.

The vision for tomorrow campus would be to know that uncertain, unpredictable change happens within our curriculum plans. If we focus more on how students learn and how teachers teach, as opposed to what students learn and what teachers teach, we can more effectively enter into healthy relationship in all domains of learning (social, material, emotional, conceptual and practical). Students will be emotionally, skillfully and conceptually competent and better equipped and motivated to meet the challenges we face in the world today. I used kitchen-based pedagogy as an example of what this looks like. Educators and practitioners could adopt the KBL learning systems model across disciplines and into other pedagogies and curricular designs that are experiential, embodied and embedded in nature. ONL also provides an accessible guiding framework for entangled leaning. Sustainability happens unconsciously and emerges into consciousness when the student experiences change.

In designing a vision for tomorrow's campus, nature and culture are not only important, but entangled—with no chance in separating them. A radical relationality sees human and nonhuman as not only interdependent but intra-dependant.

From new architecture and built infrastructure to curriculum and community engagement, it would be an ecological process of intra-dependence. In this way of *being sustainability* the core of a new paradigm for higher education would be reached. The implication of this way of living and learning would bring us closer to a way of living intra-connected human and nonhuman world. If we view all non-living and living things on Earth as co-constitutive, then perhaps we would treat Earth as if it *mattered*.

References

AASHE. (2010). *Sustainability curriculum in higher education: A call to action*. Association for the Advancement of Sustainability in Higher Education. http://www.aashe.org/files/A_Call_to_Action_final(2).pdf. Last Accessed February 22, 2016.

Barad, K. (1998). Getting real: Technoscientific practices and the materialization of reality. *Differences: A Journal of Feminist Cultural Studies, 10*(2), 87–126.

Barad, K. (2003). Posthumanist performativity: Towards an understanding of how matter comes to matter. *Signs: Journal of Women and Culture and Society*, *28*, 801–831.

Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham: Duke University Press.

Bateson, G. (1972). *Steps to an ecology of mind: Collected essays in anthropology, psychiatry, evolution, and epistemology*. San Francisco: Chandler Pub. Co.

Belliveau, C. (2007). *A new look at Dewey's cooking lab: A pedagogical model for interdisciplinary learning in contemporary higher education* (Doctoral dissertation). The Faculty of the Graduate College, The University of Vermont.

Capra, F. (2004). *The hidden connections: A science for sustainable living*. New York: Anchor Books.

Deleuze, G., & Guattari, F. (1987). *A thousand plateaus: Capitalism and schizophrenia*. Minneapolis: Minnesota Press.

Heldke, L. M. (1992). Foodmaking as a thoughtful practice. In D. W. Curtain & L. M. Heldke (Eds.), *Cooking, eating, thinking: Transformative philosophies of food* (pp. 203–229). Indianapolis, IN: Indiana University Press.

Heron, J. (1992). *Feeling and personhood: Psychology in another key*. Newbury Park, CA: Sage.

Immordino-Yang, M. H., & Damasio, A. R. (2007). We feel, therefore we learn: The relevance of affective and social neuroscience to education. *Mind, Brain, and Education, 1*(1), 3–10.

Jickling, B., & Wals, A. E. J. (2012). Debating education for sustainable development 20 Years after Rio: A conservation between Bob Jickling and Arjen Wals. *Journal of Education for Sustainable Development., 6*(2), 49–57.

Jones, P., Selby, D., & Sterling, S. R. (2010). Sustainability education: Perspectives and practice across higher education. London, Sterling, VA: Earthscan.

Lange, E. (2004). Transformative and restorative learning: A vital dialectic for sustainable societies. *Adult Education Quarterly, 54*(2), 121–139.

Lange, E. (2009). Fostering a learning sanctuary for transformation in sustainability education. In J. Mezirow & E. Taylor, Associates (Eds.), *Transformative learning in practice* (pp. 193–204). San Francisco, CA: Jossey-Bass.

Lange, L. A. (2012). Transforming transformative learning through sustainability and the new science. In E. Taylor & P. Cranton (Eds.), *Handbook of transformative learning* (pp. 195–211). San Francisco, CA: Jossey-Bass.

Lenz-Taguchi, H. (2010). *Going beyond the theory/practice divide in early childhood education: Introducing an intra-active pedagogy*. London: Routledge.

Moore, J. (2005). Is higher education ready for transformative learning? A question explored in the study of sustainability education. *Journal of Transformative Education, 3*(76), 91.
O'Neil, J. K. (2015). "Cooking to learn" while "learning to cook": (be)coming an (re)membering sustainability (doctoral dissertation). ProQuest LLC. (UMI Number 3705566).
Orr, D. (1992). *Ecological literacy*. Albany, NY: SUNY.
O'Sullivan, E., Morrell, A., & O'Connor, M. A. (2002). *Expanding the boundaries of transformative learning: Essays on theory and praxis*. New York, NY: Palgrave.
O'Sullivan, E. V. (1999). *Transformative learning: Educational vision for the 21st century*. London: Zed Books.
Spretnak, C. (1999). The resurgence of the real: Body, nature, and place in a hypermodern world. In P. B. Corcoran & A. E. J. Wals (Eds.), *Higher education, sustainability, and the role of systemic learning*. New York: Routledge.
Sterling, S. (2001). *Sustainable education re-visioning learning and change*. Bristol, UK: Green Books Ltd.
Sterling, S. (2004). *Whole systems thinking as a basis for paradigm change in education: Explorations in the context of sustainability* (Ph.D. thesis, University of Bath). Retrieved March 8, 2012 from http://www.bath.ac.uk/cree/sterling/sterlingthesis.pdf
Sterling, S. (2010). Living 'in' the Earth—Towards an education for our times. *The Journal of Education for Sustainable Development, 4*(2), 213–218.
Sterling, S. (2011). Transformative learning and sustainability: Sketching the conceptual ground. *Learning and Teaching in Higher Education, 5*, 17–33. (University of Plymouth, UK).
Sutton, D. E. (2010). Food and the senses. *Annual Review of Anthropology, 39*(1), 209–223. doi:10.1146/annurev.anthro.012809.104957
Taylor, R. (2013). *Taking sides: Clashing views in sustainability* (2nd ed.). McGraw-Hill/Dushkin.
Tilbury, D. (2011). *Education for sustainable development: Expert review of processes and learning*. UNESCO.
World Commission on Environment and Development. (1987). Our common future. Oxford: Oxford University Press.

Author Biography

Joy Kcenia O'Neil, Ph.D., is a transdisciplinary scholar-practitioner at the confluence of streams in environmental science, water resources management, transformative sustainability education and ecological food studies. She has been teaching in the natural sciences for 15 years and 8 of those years served as an administrative director for the adult, evening and weekend degree program of the Math and Science Department at the College of Santa Fe. Currently, she is the first Assistant Professor of Educational Sustainability within the College of Education at the University of Wisconsin-Stevens Point (UWSP). At UWSP, she is leading a team in building a doctoral program in Educational Sustainability (pending HLC approval) and directing an educational sustainability center. Her current teaching and/or curriculum building includes ecological whole systems thinking, brain based learning, sustainability leadership, and transformative learning. Her research focuses on relational, affective and social learning as the centerpiece of curricular consciousness and student-material intra-actions for social and ecological *change*. She is presenting a portion of her research at the 3rd World Symposium on Sustainable Development and Universities, MIT, September 2016 and the 12th Annual International Transformative Learning Conference, Tacoma, Washington, October 2016. Dr. O'Neil can be reached at: joneil@uwsp.edu and website at: https://www.uwsp.edu/eddsustainability.

Green Campus as an Integral Part of Sustainable University: Students' Perceptions

Eglė Katiliūtė and Jurgis Kazimieras Staniškis

Abstract

The implementation of green campus initiatives is not a new trend among universities. But are these campus activities only sporadic or are they part of the sustainable university's vision? This paper presents a systemic approach to sustainable university where green campus is an integral part and a result of sustainable university. The paper analyses the case of a university in a transition country in Central Europe and describes the progress made in sustainable university field during the last four years. A special emphasis is given to the integration of sustainability into the university's strategy, teaching, and research processes; the university's impact to society; students' perceptions of green campus and its relation with sustainable university concept. The analysis of students' survey results helps to identify problems and invoke initiatives for developing value based on green campus. Finally, some concrete steps which may be undertaken by universities in order to become more sustainable (considering not only the infrastructure of the campus) are outlined. This paper will be useful to anyone interested in the holistic approach to sustainable university and students' involvement in sustainable development of university.

Keywords

Green campus · Sustainable university · Students involvement

E. Katiliūtė (✉) · J.K. Staniškis
Kaunas University of Technology, K. Donelaičio St. 73, 44029 Kaunas, Lithuania
e-mail: egle.katiliute@ktu.lt

J.K. Staniškis
e-mail: jurgis.staniskis@ktu.lt

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_24

1 Introduction

Universities have the unique academic freedom and the sheer exposure to critical thinking to comment on society and its challenges, and to engage in bold experimentation in environmental sustainability (Cortese 2003; James and Card 2012). They are the manifestations of longevity and social stability with a non-profit focus and a special capacity to foster long-term thinking that is critical for sustainability (Stephens et al. 2008; Trencher et al. 2014). Critically, universities' educational role does not end with undergraduate and postgraduate learning; it extends to the plethora of activities which support and extend the teaching and research core: campus management and operations; campus planning, design, construction and renovation; purchasing; transport; and engagement with the wider community. The awareness that universities can teach and demonstrate the theory and practice of sustainability through the recognition and reduction of unsustainable impacts of their own activities is also growing in the higher education sector. The linkage of curricula and campus operations under the aegis of sustainability can create a powerful "shadow curriculum" which emphasises the nexus between theory and practice (Osmond et al. 2013). Universities have started to understand their responsibilities in sustainable development 20 years ago. We can find empirical studies, recommendations, case studies from different continents about the greening of higher education institutions. Despite the growing interest of researchers on sustainable development of universities, the systemic transformations towards sustainability is still challenging and lacks the conceptual maturity and empirical research, especially in transition countries in Central and Eastern Europe (Dagiliūtė and Liobikienė 2015). Certainly, top managers play a key role in sustainable development of higher education institutions; however, it is equally important how students recognise sustainability expression in their university and their own day-to-day practices.

One of the Lithuanian higher education institution (hereinafter LitUniversity) saw significant changes in the last four years. LitUniversity has made a commitment not only to "greening" its campus, but also to integrate sustainability principles in strategic documents and in day-to-day practices. In 2012, LitUniversity's Strategy 2012–2020 was approved. The Strategy defined five strategic actions and the main priority fields. LitUniversity's Renewal Programme and Implementation Plan 2013–2014 (hereinafter the Renewal Programme) was developed and approved in 2013 in order to achieve the strategic goals. The Renewal Programme determined the essential principles for the reorganization of higher education and research management in such a manner that it would ensure a high level of scientific research and cross-disciplinary development, open and flexible programmes of study based on research and involving problem-based learning, innovative learning methods, possibilities for students to use the University's research and educational potential, comfortable and supporting environment, attractiveness of the University to students, teachers, business and social partners.

LitUniversity undertakes five strategic actions (hereinafter the SA) covering its priority field which are listed in LitUniversity's Strategic Action Plan: (SA1) Student competence building to ensure their self-expression and successful career; (SA2) Development and transfer of internationally recognized knowledge and technologies; (SA3) Concentration of University's activities for human well-being and sustainable development of the country; (SA4) Sustainable development of the University ensuring performance quality and effectiveness; (SA5) Development and promotion of the University's academic environment and infrastructure. To ensure the implementation and coherence of strategic goals, the annual planning process for LitUniversity organizational units (faculties, research institutes, administration and supporting units) was started in 2012. Organizational units: plan their contribution to the University's aims and fulfilment of strategic indicators; prioritize their activities; set performance indicators by strategic areas; define measures to be applied by the unit to achieve the strategic goals; and identifies responsible for these measures and implementation deadlines. Annual action plans of the faculties, research institutes, and central administration are discussed and reviewed by the Rector and vice-rectors, directors of departments and are approved by the Rector's order. These plans are related with the unit's budget. Annual action plans of academic units are drawn following the unit's SWOT analysis and are accessible to all employees of the academic unit in the internal Document Management System and Academic Information System.

In 2012, during the implementation of the project LitUniversity—the Green University, the academic community started sorting waste in a coordinated and systematic manner: the system for paper sorting, collecting and shipping processes was developed by the team of LitUniversity's researchers and infrastructure staff; environmental education activities were carried out for service personnel (i.e. cleaning ladies and managers); the initiatives for the deployment of waste sorting system in the dormitories of LitUniversity were started (e.g. The green dormitory campaign); the energy efficiency and energy saving programmes were introduced; the development of sustainable mobility plan was initiated; the collection of other recyclable materials (plastic, glass, electronic waste) was started. LitUniversity was recognized as one of the most rational energy consumers.

Sustainable development, promoting responsible, environmentally friendly conduct and the formation of ecological culture is one of the LitUniversity's priorities. Its activities carried out in 2012 were internationally positively recognized during the assessment of the European Union—QUESTE-SI accreditation. LitUniversity also became a member of the Global Compact agreement in the same year.

Experience and best practices of the LitUniversity about the sustainability integration into university's strategy, teaching, and research processes in the documentation level could serve as a good example; however, it is equally important to ensure that these good initiatives become more systematic practices recognized by the whole academic community, especially students.

Dahle and Neumayer (2001) found that students should be "employed" as advocates for green issues. Such a "bottom-up" approach might be more effective as students probably feel freer to criticise campus actions and decisions than academics and staff. As "customers" at their higher education institutions, students furthermore have a lot of power for demanding the accomplishment of greening initiatives. Students acting as "green" examples to their fellow students might also be effective, as the attitude comes from peers, and not just from staff "telling people what to do" (Dahle and Neumayer 2001).

Research on understanding how to increase student participation in environmental initiatives is important as students will then adopt the principles they have learnt and apply these to the wider world; therefore, by positively influencing behaviour at this stage, this could result in pro-environmental attitudes later on in life. Of course, the research should also examine the ways in which the initiatives impact on staff that are equally important, given that they are the ones who need to support and promote environmental initiatives (Figueredo and Tsarenko 2013).

This research emphasises students' pro-environmental behaviour and perceptions of the university's campus as green campus.

The purpose of the research is to explain a systemic approach to sustainable university where green campus is an integral part of sustainable university and to identify the students' attitudes and behaviours towards sustainability.

2 Theoretical Framework

2.1 Green Campus as a Part of Sustainable University

Shriberg (2002) argues that universities must go beyond adding classes on environmental issues and move toward a fundamental reorganization of how these institutions educate students, conduct research, interact with local communities and ecosystems, operate their campuses, and provide an ideal for other social establishments (James and Card 2012). It means that universities are responsible for systemic transformation. Campus greening initiatives is only one step in long way journey towards sustainability. As university's mission is to provide leadership of sustainability for broader society, the first step is to encourage academic community's commitment to sustainability. Sharp (2002) argues that we have very few examples of universities that have actually institutionalized a systemic commitment to environmentally sustainable campus operations, realizing the enormous efficiencies and opportunities that can be gained in adopting systems based on integrated design of new resource flows and infrastructure developments. He emphasizes difference between project success and institution transformation.

James and Card (2012) lay out that universities need a balanced, facilities driven strategy where institutions view their campus facilities as a living and learning laboratory. Culture is the key factor underpinning success in terms of developing the necessary commitment to participate in such a living and learning laboratory.

JPI Urban Europe defines living labs as 'a forum for innovating… [and] the development of new products, systems, services, and processes, employing working methods to integrate people into the entire development process as users and co-creators, to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and real contexts'. The key strengths of the living lab approach are that it provides a systematic approach to facilitate student (and academic) engagement with applied sustainability issues. Questions are co-produced through consultation between non-academic and academic stakeholders within a clearly bound institutional and geographical context (Evans et al. 2015).

But universities are multi-structured, complex organization that exists without any single observation point or any single control centre from which university wide changes can be programmed and implemented. Further to this there are numerous subcultures of decision-making styles, time constrains, priorities and experiences that exist within the university organization and varying degrees of differentiation among schools and also among students, administration and faculty within schools (Sharp 2002). Disterheft et al. (2014) suggest that participatory approaches are an important requirement in order to contribute both to a global paradigm shift towards sustainable development and to ensure the integration of sustainability into the university culture. The university community (including students and non-teaching staff) could be invited to seek and experiment new routes towards a culture of participation that would enable the broadening of new ideas about sustainability in higher education (Filho et al. 2015). Furthermore, students must be made aware of how their habits and choices on campus influence the institution's own environmental "footprint", before a change towards environmentally sustainable behaviour can be expected to take place (Dahle and Neumayer 2001).

Students are specific subculture in university that have limited understanding of how the university itself is managed and no immediate access to decision-making processes. Despite these obstacles, an increasing number of students are turning their attention to getting the university to become environmentally responsible in campus operations, curriculum and research (Sharp 2002). Therefore, understanding students' evaluations of sustainability practices in universities is also assuming importance; it enables decision-makers to gain a better picture of the university's performance from the perspective of one of their major stakeholder groups (Nejati and Nejati 2013; Filho et al. 2015).

2.2 Values and Environmental Behaviour

The literature indicates that environmental attitudes and situational and psychological variables are likely to be important predictors of pro-environmental behaviour (Davis et al. 2009). Within the psychology discipline, many models have been developed to steer consumer behaviour towards environmental sustainability. For example, the reasoned action paradigm (Kaise et al. 1999), the norm-activation

model (Thorgersen 1999), the value-belief-attitude-immediate sequence-behaviour school (Scott and Jobber 2000), and the awareness-information-decision-action model (Barr 2003). Although these theoretical models vary in their names and descriptions, they share a common conceptual foundation, i.e. environmentally sensitive behaviour starts with individuals having an understanding of the consequences of their behaviours (knowledge). It affects their attitudes about the environment, leading to behaviours congruous with the sustainability agenda (Too and Bajracharya 2015).

Stern and Dietz (1994) argue that attitudes of concern about environmental issues are based on a person's more general set of values. That is, attitudes about environmental issues are based on the relative importance that a person places on themselves, other people, or plants and animals which Stern and Dietz (1994) labelled egoistic, social-altruistic, and biospheric (Schultz 2001). However, a number of studies (Gutiérrez 1996; Stern et al. 1995). Thogersen and Grunert-Beckmann (1997) appear to have demonstrated the relationship between the values of this scale and environmental behaviour (Corraliza and Berenguer 2000). Gutiérrez (1996) uses these value dimensions as predictive variables of three types of behaviours, which he calls good citizen, activist, and healthy consumer, along with an index based on them. As this author points out, the influence of values on environmental behaviour is evident. Nevertheless, the same values do not influence all types of behaviour, nor in the same way. This fact has also been indicated in other works (McCarty and Shrum 1993, 1994), in which the authors show a values-attitude-behaviour hierarchy in recycling behaviour, demonstrating the influence of values on attitudes and on behaviour. Thogersen and Grunert-Beckmann (1997) attempted to investigate the importance of values, both in the formation of attitudes and in the determination of environmental behaviour. They also tried to show that the influence of values is mediated by attitudes. They concluded their study by underlining the aptness of a values-attitude-behaviour hierarchical model for the explanation of recycling behaviour. However, at an empirical level, it was found that percentages of explained variance for recycling behaviour are quite low. The authors point out the limited significance of values as direct predictors of behaviour (Newman 1986; Corraliza and Berenguer 2000). Figueredo and Tsarenko (2013) argue that the self-perception of "being green", i.e. having pro-environmental attitudes and behaviours, is the primary driving factor which encourages participation.

3 Methods

A questionnaire was developed following the scientific literature about environmental behaviour, the recycling research, and was partly based on a questionnaire previously used in order to observe how individual values influence their purchase intention of electric vehicles (Afroz et al. 2015).

The survey was split into five sections: the first sought to determine students' pro-environmental behaviour; the second section assessed personal values; the third section aimed to reveal the subjects' satisfaction with life; the fourth sought to perceive students' awareness on LitUniversity's campus green initiatives; while the fifth section analysed subjects' demography. The current questionnaire contained questions on sustainability issues specific to LitUniversity.

The content of each section is provided below:

1. *Personal pro-environmental behaviour* (*recycling/energy efficiency)/environmental orientation*—for example, the frequency of recycling at home/at university, conserving energy, taking public transport. The first set of questions included a list of 42 environmental actions (16 items taken from Corraliza and Berenguer 2000). Each behaviour was rated from 1 (never) to 4 (always). It was the first approach to determine students' pro-environmental behaviours at home and at university. The purpose of this was to determine if there was any correlation between home and university-based actions and attitudes.
2. *Personal values* (Self-transcendence, Conservation and Self-enhancement). To assess values concerning the environment, a 9-item scale taken from Afroz et al. (2015) was used. It covered three factors: altruism, egoism, and conservatism. Examples of items measuring self-transcendence are universalism (equality—brotherhood, equal opportunity) and benevolence (helpful—working for the welfare of others). Items measuring conservation include conformity (restrained, self-disciplines and polite) and security (clean, neat and tidy). Examples of self-enhancement items are achievement (aspiring and hardworking) and power (social recognition, respect and admiration) (e.g. success: for the achievement of my life, hardworking and aspiring is important to me) (Afroz et al. 2015). According to Schwartz (1992), in any culture, values are ordered along two dimensions. The first extends from the self-enhancement pole (self-interest) to the self-transcendence pole (altruism); the second dimension contrasts values associated with openness to change with conservative values (Corraliza and Berenguer 2000). In this survey openness to change was not evaluated. Five-point rating scales were used, with indicating a negative view (strongly disagree) and higher numbers indicating a positive view (strongly agree).
3. *The satisfaction with life scale (SWLS)* (Diener et al. 1985). The SWLS is intended to assess an individual's global judgment of her or his life satisfaction. The importance of maintaining positive levels of subjective well-being has been articulated by researchers. Frederickson (1998) provides evidence that positive subjective experiences serve to broaden and build resources, regulate negative affective experiences, and protect health. Studies of correlates of life satisfaction (Veenhoven 1988) suggest that positive life satisfaction is linked with positive social interactions, broadened perception and creativity, active involvement in community and political organizations, fewer physical complaints, and longer lives (Huebner 2004). The idea in this research was to assess the correlation between students' pro-environmental behaviour and satisfaction with life.

4. *Perceptions on green university activities* (how green campus activities influence students day-to-day environmental actions, which green initiatives communication channels are acceptable to students and what would encourage students to be active agents of sustainable university). This part of the questionnaire contained two five point rating scales (for importance of the greening campus problems identification and for students' incentives to take part in Green University activities). For indicating the information sources on Green University activities dichotomous scale were used.
5. *Demographic information*—age, gender, study cycle, faculty.

Data were gathered using a structured self-completion questionnaire from LitUniversity students. The questionnaires were prepared in a paper form which were printed on recycled paper. Prior to distributing the questionnaire, the pretesting procedure with seven people (two students, two green campus experts and three university teachers), was conducted. The survey was conducted during November–December 2015.

The total sample consisted of 311 students of LitUniversity. Statistically, the sample size was representative of the population with 5 % standard error and 95 % confidence level. *M*ost participants were studying in bachelor study cycle (69 %), 18–21 years old (68 %), mainly students in School of Economics and Business (39 %). More than half of them lived in university's dormitories (57 %), male (51 %) and female (49 %).

SPSS 20.0 for Windows was used to process the collected data. The internal consistency and reliability of the questionnaire developed and piloted for this study was rested with Cronbach's alpha resulting in a level of statistical significance of $\alpha = 0.05$. The Cronbach's values of the tool were 0.54–0.93 (see Table 1).

4 Results

4.1 Personal Values, Satisfaction with Life and Environmental Behaviour

Bivariate correlations were examined in order to determine the associations between waste sorting, electricity and water conservation behaviours at home and at university, students' incentives, greening university problems, personal values and satisfaction with life. As shown in Table 2, there were significant positive correlations between home recycling and university recycling behaviours, and between satisfaction with life and personal values.

However, results of personal values and life satisfaction were not significantly related with recycling behaviour. Small but statistically significant relation between conservation values and electricity and water conservation behaviour was determined ($r = 0.141$, $p < 0.05$).

Table 1 The statistical information about the instrument

Items	Stand. loadings	Reliability
Self-transcendence value (*Altruism*)		0.81
Helpfulness is important to me	0.78	
Forgiveness is important to me	0.74	
Love and affection is important to me	0.85	
Friendship and generosity is important to me	0.86	
Conservation values (*Conservatism*)		0.76
Respectfulness and politeness is important to me	0.85	
Self-control, such as, restrained and self-disciplined is important to me	0.83	
Clean and tidy environment is important to me	0.79	
Self-enhancement values (*Egoism*)		0.54
Success: For the achievement of my life, hardworking and aspiring is important to me	0.83	
Self-satisfaction: Enjoyable and leisurely life is important to me	0.83	
The satisfaction with life (*Satisfaction*)		0.84
In most ways my life is close to my ideal	0.80	
The conditions of my life are excellent	0.81	
I am satisfied with my life	0.87	
So far I have gotten the important things I want in life	0.76	
Home recycling behaviours		0.93
I recycle plastic at home	0.88	
I recycle paper at home	0.89	
I recycle glass at home	0.88	
University recycling behaviours		0.92
I recycle plastic at university	0.89	
I recycle paper at university	0.88	
I recycle glass at university	0.84	
Electricity and water conservation		0.78
I don't keep an electronic equipment in stand-by regime	0.71	
I switch off the light when I leave	0.70	
I always conserve electrical energy	0.66	
I save water in a bathroom	0.65	
I save water when I wash dishes	0.61	
Attractive communication as incentive		0.76
More attractive and repeated invitation to green activities	0.82	
More discussion on green initiatives within academic community	0.78	
If the information map on green activities based of GIS would be available	0.77	
Personal benefit and convenience as incentive		0.73
If I would pay less for living in dormitory	0.83	
Better visibility of personal green actions results	0.69	
More waste sorting bins	0.64	
More show elements in green activities	0.59	

Table 2 Correlations for pro-environmental behaviours, the satisfaction with life and personal values

	1	2	3	4	5	6	7	8	9
1. Self-transcendence value (Altruism)	1.000	0.379**	0.617**	0.168**	−0.006	0.012	0.093	0.039	0.043
2. Conservation values (Conservatism)		1.000	0.285**	0.381**	0.063	0.109	0.141*	0.163**	0.119*
3. Self-enhancement values (Egoism)			1.000	0.160**	0.008	0.033	0.099	0.006	0.027
4. The satisfaction with life (Satisfaction)				1.000	−0.005	0.056	0.064	0.159**	0.134*
5. Home recycling behaviours					1.000	0.427**	0.184**	0.140*	0.089
6. University recycling behaviours						1.000	0.134*	0.191**	0.196**
7. Electricity and water conservation							1.000	0.138*	0.093
8. Attractive communication as incentive								1.000	0.436**
9. Personal benefit and convenience as incentive									1.000

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

The research made by Dagiliūtė and Liobikienė (2015) indicates that environmental concern, environmental values and willingness to assume responsibility for the solution of environmental problems have a significant and direct impact on environmentally friendly behaviour. Willingness to take responsibility has the largest influence on environmentally friendly behaviour. Therefore, the most important task for the university is to develop the willingness to contribute to solve environmental problems and to provide more knowledge on how to behave in a more environmentally friendly way. This could be fulfilled by offering special courses for students. Figueredo and Tsarenko (2013) demonstrates that the effect on willingness of being green is not transmitted explicitly; as such, this effect can be more fully understood through interactional processes with mediating factors. Such activities (e.g. recycling; using public transport) can be considered to be pro-environmental behaviours leading to a perception of "being green" but these activities may have other underlying reasons such as compliance with the rules, aspiration to fitness or convenience that on the surface indeed coincide with the self-perception of "being green".

Correlation analysis revealed significant positive correlations between the life satisfaction and attractive communication as students' incentive ($r = 0.159$, $p < 0.01$) and personal benefit and convenience as incentive ($r = 0.134$, $p < 0.05$).

4.2 Perceptions of Green University Activities Impact

Students recognize that the university greening activities have the major impact on their recycling behaviour (37 %). Nineteen per cent of students agreed that university has impact on their habit of electricity saving and only 16 % identify major

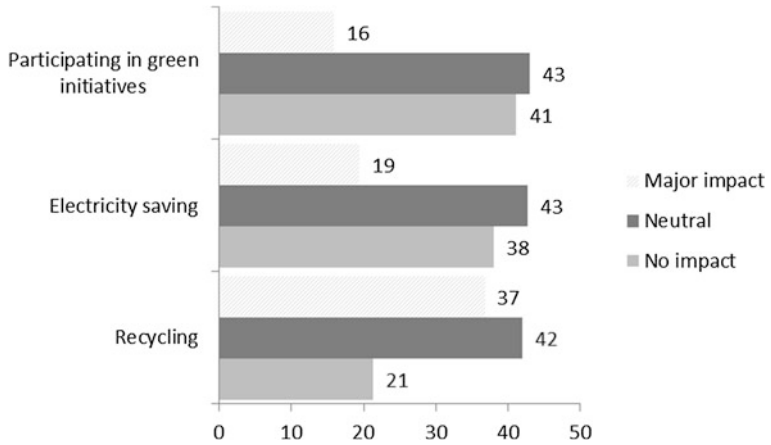


Fig. 1 Green university impact on students day-to-day practices (% from all respondents, n = 311)

university impact on their participation in green initiatives (Fig. 1). More than half of research participants did not recognise any university's influence.

4.3 Green Initiatives Communication Sources

Students were asked how they became familiar with green university's initiatives. Research results revealed that most popular information source is Internet, second —public actions and labelling, third—notice-board (Fig. 2). They mostly preferred public versus personal information sources. Figueredo and Tsarenko (2013) underline that educating students via the university webpage, newsletter, blog and environmental pledge provides a flexible channel for self-education. When considering these types of initiatives, it is noticed that most of them are relatively simple, do not require much time and effort, and are safely within the locus of control of the participant. Initiatives such as these do not require a great deal of commitment and participation is easy. Dahle and Neumayer (2001) also noted that a number of activism efforts at higher education institutions, such as seminars, open lectures, dedicated sustainability web sites, newsletters, print material, student organizations, and guidance booklets, are effective means of raising sustainability awareness. Communication was most oftenly considered as a 'very important' critical success factor for participatory processes, together with strategy with a clear goal in Disterheft et al. (2014) research findings.

It is not surprising that press is the least popular information channel. University's administration staff voice could be more recognizable, whereas only 11 % of students got information about green university initiatives from this critical information channel.

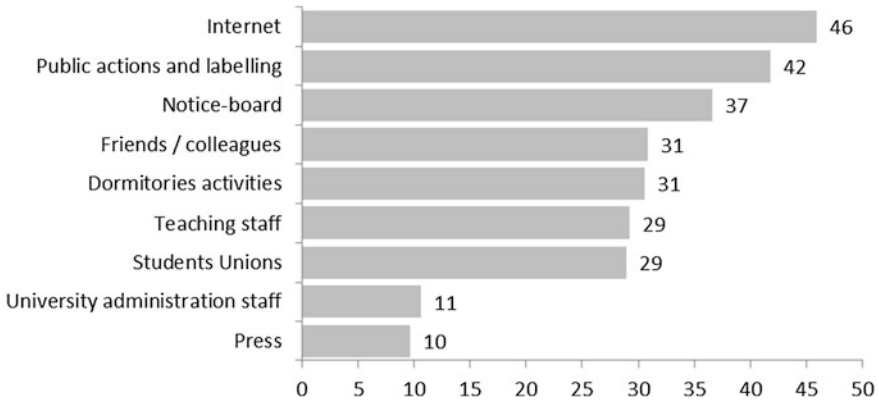


Fig. 2 Information sources on green university activities (% from all respondents, n = 311)

4.4 Students' Incentives to Take Part in Green University Activities

Students were asked to evaluate the incentives to take part in Green University activities. The most influential motivator for students' participation is economical (Fig. 3). Seventy-two per cent of the students agreed that they will be more involved in greening university if they had the possibility to pay less for living in dormitory. It usage and some "show elements" in green university activities are also among good incentives for students' involvement. Less attractive but also important means from students' perspective is more discussion on green initiatives within academic community. Figueredo and Tsarenko (2013) state that awareness about the university's campaigns and its environmental programmes has a positive influence on students' pro-environmental behaviour as these initiatives foster both pride and enthusiasm of students. Students have a sense of belonging to an organisation which is doing what it is preaching.

5 Discussion and Conclusions

The paper presents a new insight to the expression of sustainability in greening the university by integrating students' viewpoint. The development of sustainable university practices in everyday activities forms new values and attitudes, which are reflected in culture and behaviour of academic community. It changes students' attitudes and influences pro-environmental behaviour.

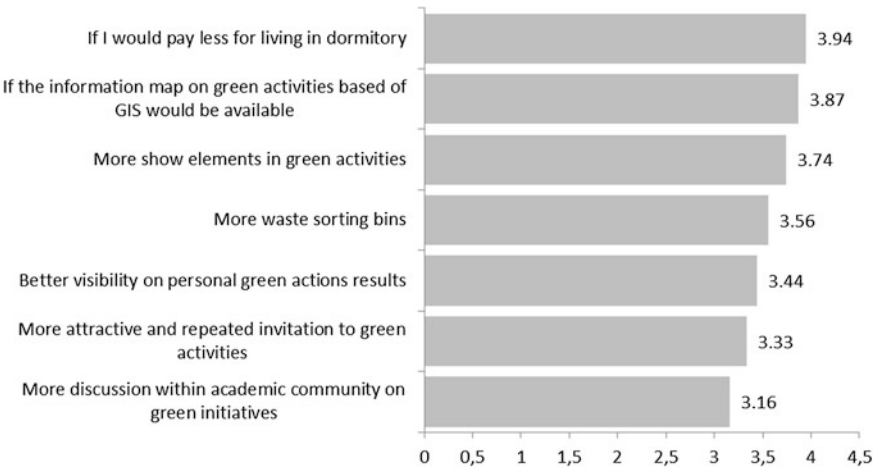


Fig. 3 Students incentives to take part in green university activities (Mean, 5-point scale, n = 311)

Universities expect active students' involvement in university greening activities and it could happen, however students usually spend in university from 2 to 6 years. Therefore, actual information about university's greening activities must be regularly repeated in acceptable communication channels for students. Despite the fact that the variety of community's age in university could represent the whole micro society, our newest students mostly belong to the first generation that has never known any reality other than one that is facilitated by the Internet, mobile devices, and social networking (Friedrich et al. 2011).

The aim of sustainable university is to see the campus as a living and learning laboratory, based on Living lab approach. König and Evans (2013) argue that a major challenge for universities involves negotiating the institutional and disciplinary tensions between addressing applied sustainability challenges and more traditional remit of universities to engage in blue skies research and train 'disciplined' thinkers. It is argued that Living labs have the potential to reconcile these tensions by integrating research, curricula, pedagogical method and community engagement, offering new spaces for experiential learning in diverse communities.

The research revealed the important role of teachers. Thirty per cent of students participating in the survey confirmed that information and motivation on green initiatives came from studies, despite the fact that 20 % of students have spent only 3–4 months at the university.

The economic benefit is one of the key incentives for students to participate in green activities. For instance, less payment for living would be sufficient motivation for students' participation.

The survey has determined statistically significant relation between pro-environmental behaviour dimensions at home and at university. For instance, if student recycles at home, he or she recycles at university as well; if he or she saves energy, then he or she saves water as well. That is why the first step in pro-environmental behaviour is crucial. The more students' personal values are conservative, the more he or she is willing to participate in energy and water reduction activities, the more satisfied life he or she lives, the better environmental friendly he or she behaves.

With a view to achieve the best greening campus results, studies, research and students' involvement have to be integrated.

The scientific insights regarding the university's sustainability as an institutional transformation case/practice prescribes the necessity of further research. Additional quantitative and, especially, qualitative studies coherent with organizational culture issues are needed.

References

Afroz, R., Rahman, A., Masud, M. M., Akhtar, R., & Duasa, J. B. (2015). How individual values and attitude influence consumers' purchase intention of electric vehicles—Some insights from Kuala Lumpur. *Malaysia. Environment and Urbanization Asia, 6*(2), 193–211.

Barr, S. (2003). Strategies for sustainability: Citizens and responsible environmental behaviour. *Area, 35*(3), 227–240.

Corraliza, J. A., & Berenguer, J. (2000). Environmental values, beliefs, and actions a situational approach. *Environment and Behavior, 32*(6), 832–848.

Cortese, A. D. (2003). The critical role of higher education in creating a sustainable future. *Planning for Higher Education, 31*(3), 15–22.

Dagiliūtė, R., & Liobikienė, G. (2015). University contributions to environmental sustainability: challenges and opportunities from the Lithuanian case. *Journal of Cleaner Production, 108*, 891–899.

Dahle, M., & Neumayer, E. (2001). Overcoming barriers to campus greening: A survey among higher educational institutions in London, UK. *International Journal of Sustainability in Higher Education, 2*(2), 139–160.

Davis, G., O'Callaghan, F., & Knox, K. (2009). Sustainable attitudes and behaviours amongst a sample of non-academic staff: A case study from an Information Services Department, Griffith University, Brisbane. *International Journal of Sustainability in Higher Education, 10*(2), 136–151.

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49*(1), 71–75.

Disterheft, A., Caeiro, S., Azeiteiro, U. M., & Leal Filho, W. (2014). Sustainable universities–A study of critical success factors for participatory approaches. *Journal of Cleaner Production, 106*, 11–21.

Evans, J., Jones, R., Karvonen, A., Millard, L., & Wendler, J. (2015). Living labs and co-production: university campuses as platforms for sustainability science. *Current Opinion in Environmental Sustainability, 16*, 1–6.

Figueredo, F. R., & Tsarenko, Y. (2013). Is "being green" a determinant of participation in university sustainability initiatives? *International Journal of Sustainability in Higher Education, 14*(3), 242–253.

Filho, W. L., Shiel, C., & Paço, A. D. (2015). Integrative approaches to environmental sustainability at universities: An overview of challenges and priorities. *Journal of Integrative Environmental Sciences, 12*(1), 1–14.

Frederickson, B. (1998). What good are positive emotions? *Review of General Psychology, 2*, 300–319.

Friedrich, R., Peterson, M., & Koster, A. (2011). The rise of generation C. *strategy+business, 62*, 1–3.

Gutiérrez, D. (1996). Values and their effect on pro-environmental behaviour. *Environment and Behavior, 28*, 111–133.

Huebner, E. S. (2004). Research on assessment of life satisfaction of children and adolescents. *Social Indicators Research, 66*(1–2), 3–33.

James, M., & Card, K. (2012). Factors contributing to institutions achieving environmental sustainability. *International Journal of Sustainability in Higher Education, 13*(2), 166–176.

Kaise, F. G., Wolfing, S., & Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology, 19*, 1–19.

König, A., & Evans, J. (2013). Experimenting for sustainable development? Living laboratories, social learning, and the role of the university. In A. König (Ed.), *Regenerative sustainable development of universities and cities: The role of living laboratories* (pp. 1–24). Cheltenham: Edward Elgar.

McCarty, J. A., & Shrum, L. J. (1993). A structural equation analysis of the relationships of personal values, attitudes and beliefs about recycling and the recycling of solid waste products. *Advances in Consumer Research, 20*, 641–646.

McCarty, J. A., & Shrum, L. J. (1994). The recycling of solid wastes: Personal values, value orientations and attitudes about recycling as antecedents of recycling behaviour. *Journal of Business Research, 30*, 53–62.

Nejati, M., & Nejati, M. (2013). Assessment of sustainable university factors from the perspective of university students. *Journal of Cleaner Production, 48*, 101–107.

Newman, K. (1986). Personal values and commitment to energy conservation. *Environment and Behavior, 18*, 53–74.

Osmond, P., Dave, M., Prasad, D., Li, F., & Clayton, J. (2013). *Greening Universities toolkit: Transforming universities into green and sustainable campuses—A toolkit for implementers*. United Nations Environment Programme (UNEP).

Schultz, P. W. (2001). The structure of environmental concern: Concern for self, other people, and the biosphere. *Journal of Environmental Psychology, 21*(4), 327–339.

Schwartz, S. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. In M. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 25, pp. 1–65). Orlando, FL: Academic.

Scott, B. F., & Jobber, D. (2000). Environmentally responsible purchase behavior: A test of a household model. *European Journal of Marketing, 34*, 723–746.

Sharp, L. (2002). Green campuses: The road from little victories to systemic transformation. *International Journal of Sustainability in Higher Education, 3*(2), 128–145.

Shriberg, M. P. (2002). *Sustainability in US higher education: Organizational factors influencing campus environmental performance and leadership* (Doctoral dissertation, The University of Michigan).

Stephens, J. C., Hernandez, M. E., Román, M., Graham, A. C., & Scholz, R. W. (2008). Higher education as a change agent for sustainability in different cultures and contexts. *International Journal of Sustainability in Higher Education, 9*(3), 317–338.

Stern, P. C., & Dietz, T. (1994). The value basis of environmental concern. *Journal of Social Issues, 50*(3), 65–84.

Stern, P. C., Dietz, T., & Guagnano, G. A. (1995). The newecological paradigm in social-psychological context. *Environment and Behavior, 27*, 723–743.

Thorgersen, J. (1999). The ethical consumer. Moral norms and packaging choice. *Journal of Consumer Policy, 22*(4), 439–460.

Thogersen, J., & Grunert-Beckmann, S. C. (1997). Values and attitude formation towards emerging attitude objects: From recycling to general waste minimizing behaviour. *Advances in Consumer Research, 24*, 182–189.

Too, L., & Bajracharya, B. (2015). Sustainable campus: Engaging the community in sustainability. *International Journal of Sustainability in Higher Education, 16*(1), 57–71.

Trencher, G., Yarime, M., McCormick, K. B., Doll, C. N., & Kraines, S. B. (2014). Beyond the third mission: Exploring the emerging university function of co-creation for sustainability. *Science and Public Policy, 41*(2), 151–179.

Veenhoven, R. (1988). The utility of happiness. *Social Indicators Research, 20*, 333–354.

Authors Biography

Prof., dr. Eglė Katiliūtė is professor at the Department of Management, School of Economics and Business, Kaunas University of Technology. Her research interests are sustainable university, sustainable development, quality management systems, higher education quality research, education policy research methodology and interdisciplinary research. She is author of more than 40 publications.

Prof., dr. hab. Jurgis Kazimieras Staniškis is director of the Institute of Environmental Engineering, Kaunas University of Technology, and a full member of Lithuanian Academy of Sciences. He is active for over two decades on sustainable development strategies and their application in industry, universities and governmental institutions in Lithuania, Central and Eastern Europe, Africa, Latin America and Asia. He is author of 12 books, more than 250 publications and 140 inventions.

A Comprehensive Sustainability Policy at the School of Economics and Business, Universidad de Chile

Francisca Sandoval, Beatriz Hasbún and Francisco García

You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.

—R. Buckminster

Abstract

The training of professionals with ethical, social and sustainable values has become a relevant focus of higher education institutions, because of different events that transcend the acceptable limits of fair and respectful social interaction with the environment. This paper presents the experience of the social-environmental sustainability office, EcoFEN, of the School of Economics and Business at University of Chile, which addresses the challenge of achieving a Sustainable Campus by 2025. The work has been done systematically during the period of 2007–2015, focusing the efforts on a policy of comprehensive sustainability, which has 4 lines of action: research, teaching, extension and management. In terms of teaching, the policy promotes the incorporation of curricular activities with a focus on sustainability; at a management level, it encourages changes in consumption practices of the institution; and at the extension level, it encourages various activities with the university community and sustainable entrepreneurs. One of the future challenges of the School is to formalize a permanent line of research in sustainability. This paper might be

F. Sandoval (✉) · B. Hasbún · F. García
School of Economics and Business, University of Chile, Santiago, Chile
e-mail: fsandoval@fen.uchile.cl

B. Hasbún
e-mail: bhsbun@fen.uchile.cl

F. García
e-mail: fragarci@fen.uchile.cl

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_25

useful for other campuses seeking to develop their own formative environment that promotes sustainable and ethical training of professionals.

Keywords
Sustainable campus · Higher education · Education for sustainability

1 Introduction

Today we live in a world with large and unbalanced environmental and ecological changes, which directly affects the lives of all beings inhabiting the ecosystem. The factors of this crisis have gestated from the top predators of the ecosystem: human beings and their actions. Human beings take opportunities for growth and create unlimited needs with finite natural resources (Waas et al. 2010).

Local and global ecological crisis shows us that we should start a paradigm shift. In this sense, conserving nature as an inexhaustible source of resources, where the only argument is confidence in human progress and technological advances, has led us to a great ecological crisis. To address this, the model of sustainable development aims to develop greater environmental awareness, in order to impose limits on the use of natural resources, necessary to protect the planet.

> Humanity has the ability to make development, sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits - not absolute limits, but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. (World Commission on Environment and Development 1987)

Universities, as organizations, are not exempt from contributing to achieving sustainable development, and it has increasingly attracted the attention of educational institutions. One of the first signs of university's commitment to sustainable development, is The Talloires Declaration (1990) (Figueiró and Raufflet 2015). The Talloires Conference gathered 31 university administrators worldwide and resulted in The Talloires Declaration, a ten-point action plan for incorporating sustainability and environmental literacy in teaching, research, operations and outreach at colleges and universities. Nowadays, it has been signed by over 350 university presidents and chancellors in over 40 countries. In this sense, the Declaration of Talloires was a starting point to several universities to begin to incorporate actions to generate more sustainable campus, both in management and in terms of the training given to their students, to form citizens committed to their environment and to contribute generating knowledge on the subject.

In this context, "*some suggest that higher education is currently experiencing a swing-back, a return, to an original purpose of cultivating civic responsibility and citizenship via a scholarship of engagement. Such movement would require institutions of higher education to model civic responsibility and engagement at the*

organizational level. It would also require that the universities' roles of teaching students and perpetuating knowledge through research need to be re-oriented or expanded to contribute more explicitly to societal needs and challenges" (Stephens and Graham 2010).

Shifting or re focusing Universities purpose to sustainable development is not an easy task, because it aims to change the very culture of the university and its members. This article present the systematization of a comprehensive sustainability policy at the School of Economics and Business of Universidad de Chile, designed to address the challenge of incorporating sustainability literacy in all the University's main activities, through changes in the way we understand institutional management, teaching, extension and research.

2 Sustainability in Chilean Higher Education

In Chile, since 2012, there is a Sustainable Campus Network, whose mission is to enhance the efforts of the Higher Education Institutions (HEI's) to consolidate the practice of sustainability in all areas of their institutional activities. In total, it brings 15 Chilean institutions of higher education together. This network has enabled universities to work together in promoting education for sustainability and organizing once a year a national conference where the best experts in the field are brought into the country.

Aiming to formalize this growing interest, the Sustainable Campus Network drafted the "Framework Protocol for Inter-cooperation: Sustainable Campus", covering two areas: education and campus management.

The Sustainable Campus Network is also running the Clean Production Agreement: a soft environmental instrument in Chile, run by the National Cleaner Production, that aims to promote clean production through productive development by guiding and promoting efforts in sustainable management of campuses throughout Chile (Red Campus Sustentable 2015). Universidad de Chile joined the The Clean Production Agreement (APL), and specifically, the School of Economics and Business.

2.1 Sustainability in Universidad de Chile

Universidad de Chile is the oldest university in the country, founded in 1842 and one of the most prestigious HEI's in Latin America. Currently, Universidad de Chile is organized in 14 faculties, 4 interdisciplinary institutes and three disciplinary centers. In 2015, the University had an enrollment of more than 28,000 undergraduate students, distributed in 71 programs. The founding statute of the University of Chile (Article 2, 2006), it states that the institution's mission:

> The generation, development, integration and communication of knowledge in all areas of knowledge and domains of culture, constitute the mission and the foundation of the activities of the University, (…) The University assumes in pursuit of excellence in training people and contribute to the spiritual and material development of the nation. It serves his mission through the functions of teaching, research and development in science and technology, humanities and the arts, and extension of knowledge and culture in all its breadth. (…) It is the responsibility of the University to contribute to the development of cultural heritage and national identity and the improvement of the educational system of the country.

Consistent with its mission, Universidad de Chile has expressed its commitment to environmentally sustainable development by signing the "Declaration of Talloires" (Senado Universitario 2012). The Sustainability Policy was approved in 2012, with the mission to lay the groundwork for a strategy that will help to transform the university into a sustainable institution, reaching all four areas: Extension, Teaching, Research and Management. It also drafts a definition of sustainability in the academic curriculum:

> Universidad de Chile defines sustainability as the aspiration of humanity to perpetuate their existence and welfare of all life forms on the planet, considering cultural, environmental and economic dimensions. From this perspective, it is understood that in the curriculum of the University, sustainability must be present in the academic programs from their basic and specific applications transversely. This was expressed by undertaking focused courses and / or related to sustainability topics in each discipline themselves, in order to form citizens with tools of systematic thinking, anticipation of future problems, environmental awareness and understanding of the regulatory and environmental aspects, management strategies, collaboration and interpersonal involvement with community profile, which will be validated within the competence of the academic programs of the University (University Decree No. 34.852).

Thus, Universidad de Chile as a public institution, appropriates these guidelines in order to develop tomorrow's professionals and expertise values from a comprehensive perspective, where they can become active, socially responsible citizens, and leading change processes.

3 Sustainability Policy at the School of Economics and Business

HEI's not only understood the importance of incorporating the issue of sustainable development, but the fact that the world of business and politics is also looking to that horizon. An example of this, is that in 2015, the agreement signed in COP 21 in Paris stressed the importance of education, training, awareness and public participation, public access to information and cooperation at all levels in matters of Climate Change. In that sense, a school of economics and business cannot be oblivious to these issues.

In particular, at the School of Economics and Business (FEN) at Universidad de Chile, created in 2009 an Office of Social Responsibility, oriented to articulate and promote social responsibility within the educational community, linking the

country's needs with the work of the School and thus contributing to sustainable human development.

Within this unit, is installed the project "ECOFEN for a Sustainable Campus" (hereinafter ECOFEN), formed in April 2013, consolidating a long history of work towards sustainability. Consistently, it's purpose is to transform this school into a leading Latin American level for 2025 Sustainable Campus (SC).

EcoFEN exists to address two key problems: at the macro level, the undeniable local and global ecological crisis, and at a micro level, preparing the institution to meet this new challenge. In fact, "EcoFEN for a Sustainable Campus" is a merger between a student organization called EcoFEN, with an institutional organization called Sustainable Campus. Therefore, today gathers initiatives related to sustainability in FEN, uniting the work of students, teachers and staff.

The importance of achieving this transformation in FEN lies in the prestige of the institution at a national and international level (INOMICS, 2013 America Economía, 2013), and the level of influence that its graduates have in the various spheres of power. Every year, more than 300 graduate professionals are graduated and take over positions of high influence in both the public and private sectors. As FEN is a living example of university sustainability becomes more likely that the decisions of these professionals are sustainable not only economically, but also environmentally and socially.

EcoFEN success is based on positioning and implementing sustainability initiatives in the daily life of the FEN. These allow the community to empathize, understand and grasp the underlying concepts of sustainability that need to be socialized today (Fig. 1).

These initiatives are part of the four lines of action of internationally recognized Sustainable Campus: management, teaching, research and extension. Framed in this conceptual system, EcoFEN has worked since 2013 strongly in this Lines of Action.

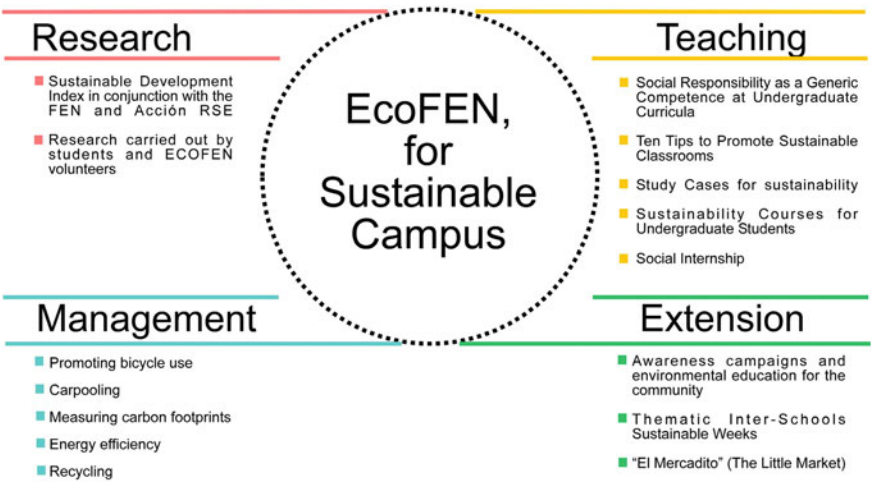


Fig. 1 EcoFEN, for a sustainable campus lines of action

3.1 Line of Action in Management

EcoFEN seeks to transform the School of Economics and Business in a living example of sustainability, from the efficient use of energy, water and paper, minimizing the carbon footprint, energy generation with NCRE (Non-Conventional Renewable Energies), water treatment and reuse, integrated management waste, among other components of an optimal and responsible management of the university campus. Some of the projects implemented to change the educational community habits are:

3.1.1 Promoting Bicycle Use

Promotes the use of alternative urban transportation, friendly to the environment and healthy for the members of the university community. It started to be implemented by 2014, with the installation of 120 bicycle parking spaces, a bike repair station and delivering security locks. This project was a success, and today is committed to expanding with 150 more parking spaces, since the use of this means of transport has amassed within the community.

3.1.2 Carpooling

In the year 2013 the initiative was approved and began implementing a virtual platform to promote carpooling, named "Aventones FEN". In this platform, users can indicate their daily routes and travel times, and the platform automatically identifies someone who travels by car on the same route. Using the platform helps to decongest the city, avoiding the emission of CO_2, consuming less fuel, and strengthen internal networks of the School.

3.1.3 Measuring Carbon Footprints

The comparative measurement of CO_2 emissions was conducted in 2012, and has been to this day an annual challenge. This measurement is based on the GHG protocol, thus addressing direct sources like liquefied gas, indirect sources as electricity, and a variety of others as attributable to paper, waste, recycling, transport, among others (Fig. 2).

3.1.4 Energy Efficiency

Energy management has been approached from the communication of best practices for the efficient use of energy in the entire university community. This has been part of a coordinated effort between different units of the school, which has facilitated the development of complementary best practices, such as changing lights to LED, air conditioning use policies, among other activities.

3.1.5 Recycling

The recycling of waste is a program that has been developed since 2008, together with the association of public and private entities. It commits the university community in the separation of waste. The implications of sustainable waste

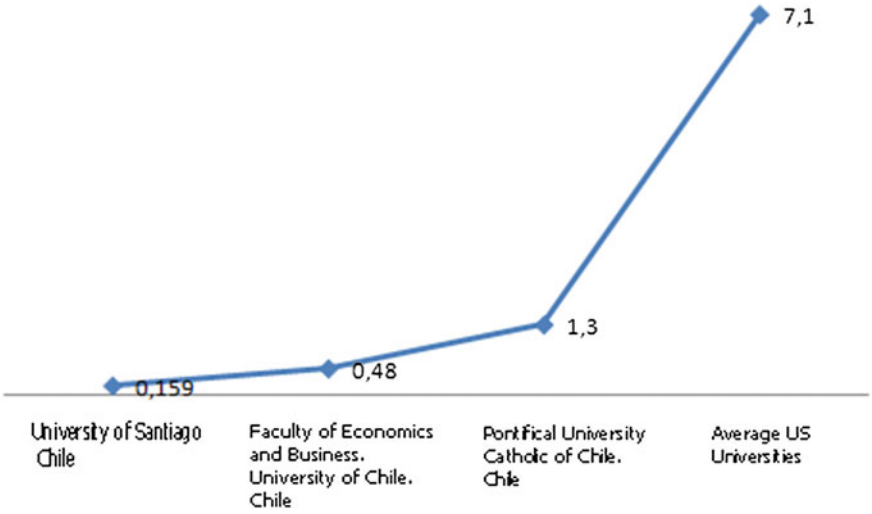


Fig. 2 CO_2 per capita emission by institution. *Source* ECOFEN (2015)

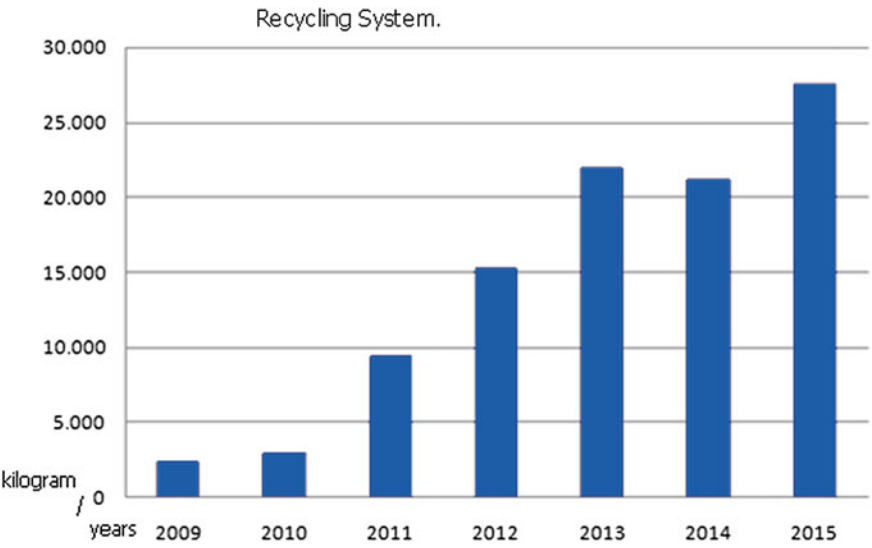


Fig. 3 Total waste recycling measured in kilograms. *Source* ECOFEN (2015)

management are a challenge we have taken as an educational institution with a vocation for public service and interest in sustainable development, promoting a university, responsible and aware of the impacts circular economy. Today in FEN, cardboard, white paper, diaries, pet-1, clear bags and film, Tetra Pak, cans, toner cartridges, ink, batteries, cell phones, electronics and peripherals are recycled. The

recycling of waste has systematically increased since 2009, as shown in the graph (Fig. 3).

3.2 Line of Action in Teaching

Along with changing the habits of the university community, ECOFEN considered important the teaching of skill, attitudes and values to contribute in this way to educate professionals who are able to deliver effective, efficient and sustainable solutions and thus can contribute to achieving processes neutralize damage and destruction caused by this environmental crisis. In that sense, we have raised the following:

3.2.1 Social Responsibility as a Generic Competence at Undergraduate Curricula

The School of Economics and Business has defined five common generic competences for its three undergraduate programs. Among these, is the competence of social responsibility, defined as:

> It is the use of a set of criteria to anticipate the impacts and making professional decisions, considering the responsibility of the various stakeholders of society and the balance of economic, social and environmental development, both to understand the context of a problem an organization or community and the development of ways of solution within the framework of sustainable human development (FEN 2015).

In that sense, it is expected that the FEN graduates are able to make decisions based on sustainability criteria, which means, as noted by the definition of the social responsibility competence and its sub-competencies, the identification of stakeholders and the consideration of different types of impact the decision-making within a company, as defined in Table 1.

3.2.2 Ten Tips to Promote Sustainable Classrooms

In order to involve teachers in training for sustainability, we worked to develop Ten Tips to Promote Sustainable Classrooms. The "Ten Tips" is a format, which

Table 1 Competence and sub-competencies definition

Competence	Sub-competence	Definition
Social responsibility	Involvement of stakeholders	Involve stakeholders, considering their needs, interests and context, for proposals and work actions
	Integrated consideration of social, economic and environmental impacts in work proposals and actions	Identify social, economic and environmental impacts both during diagnostic, performance and projection of the effects of selected measures

Source FEN (2015)

corresponds to a short document that usually deliver recommendations to teachers about their teaching practices.
The Sustainable Tips Are

1. **Reduce consumption of paper**: Avoid paper, send PDF print readings and/ or encourage your students to get the texts with peers in higher years. If you cannot avoid using paper, prefer recycled paper for printing and testing guidelines, duplex and if possible, more than one sheet of paper per side.
2. **Reuse materials at its disposal**: Reuse is not only environmentally, by lengthening the life cycle of objects, but also helps to save money. There are different materials in the Faculty that can be reused, for example, if you need to use flip charts in a session, use the informative posters that are no longer in use.
3. **Recycle waste generated in classes**: At the end of the class, ensure that you and your students have all waste (beverage cans, plastic bottles, pieces of paper, etc.) in the recycling centers available on FEN.
4. **Avoid unnecessary consumption of electricity**: Go up the blinds/curtains and make the most of available natural light, turning off the electricity in the room. Make sure the projector is turned on only if required for the class. Finally, when it ends, turn off the light and projector.
5. **Optimize the use of the air conditioning in the room**: Control environment helps improve concentration of students and reduces the consumption of electricity. Avoid the constant change of the thermostat, turning on and turning off the air conditioning. It is not only a waste of energy, but the temperature changes can be harmful to your health and that of their students. Let stable temperature at 20° if it is cold and 23° if it is hot. Close the windows if you use the air conditioning.
6. **Encourage peer or teamwork**: Peer work or teamwork not only enhances the learning of your students, allowing them to share different perspectives and experiences, but decrease the amount of material needed to implement an activity.
7. **Encourage your students and learn about the carbon footprint**: Look for relevant information on the carbon footprint and the calculation thereof through various free tools available online. Once students know the size of their footprint, you can implement various strategies for reducing and/or offsetting. We invite you to join the NPS footprint measurement.
8. **Encourage your students to prefer foods without unnecessary packaging**: Educate students about the importance of not producing unnecessary garbage in the cafeteria asking the least amount of packaging, paper bags, napkins, etc. Encourage your students to use reusable packaging.
9. **Encourage the use of public transport or bicycles**: Cars are a major source of pollution in cities. The use of public transport or bicycles represents a significant reduction in pollution of road congestion. In addition, transported by bicycle promotes physical activation and consequently, the health of your students. If you cannot use the above alternatives, share the vehicle with others during your trip.

10. **Join the digital age**: Ask your students to deliver tasks and assignments in digital format, through email and/or virtual classroom platform. Also, perform feedbacks digitally with the option to "check" available in Word. Avoid printing work to correct them.

3.2.3 Study Cases for Sustainability

In business education, case study methodology is widely used by academics, allowing students to learn based on experiences and real life situations, permitting them to build their own learning in a context that approximates to their future job performance. As part of the methodology of case studies, ECOFEN encourages that the cases used by the faculty work on the issue of sustainability, asking students to develop solutions that must incorporate the perspectives on the impacts, not only in the economic, but also social and environmental. During 2016, the first pilot of this initiative will be made.

3.2.4 Sustainability Courses for Undergraduate Students

EcoFEN is looking that FEN's students recognize the seriousness and urgency of the ecological crisis, and to acquire the skills needed to successfully confront the various occupations. This is approached with the implementation of new courses and incorporating themes related to existing courses.

Along with integrating sustainable development through generic competences and the use of active methodologies in existing courses, we have been incorporating into the course catalog of the School of Business and Economics, courses directly associated with the issue of sustainability. In that sense, there are currently two elective courses available to undergraduates who work the focus of ecology: "Introduction to Ecology" and "Ecological Economics"

3.2.5 Social Internship

For the Business undergraduate program, the Social Internship is a mandatory curricular activity, considered as a prerequisite for approving the basic cycle. In the cases of Management Control and Accounting, students can for one of two ongoing curricular activities, the Social Internship or a Skills Workshop. Some of the Social Internship results are listed below:

- So far the number of students who have completed the Social Internship is 621 students between the fall semester 2013 and summer semester 2015.
- 93.7 % of students approved the Social Internship.
- 91 social organizations have received interns from the School of Economics and Business. Of these, 75 organizations are currently active, which means that have received students, at least in two consecutive semesters.
- Both student self-assessment, and supervisor's evaluation, are satisfactory. Overall, students evaluate themselves on average with a 6.5, while their supervisors evaluated them with a 6.4. (In a scale from 1 to 7, being 7 the highest score)

3.3 Line of Action in Extension

Extension initiatives have facilitated involvement, integration and empowerment of student volunteers, social practitioners, staff and teachers, executing projects of their interests, such as:

3.3.1 Awareness Campaigns and Environmental Education for the Community

An active, informed and aware community is needed to develop projects in the area of sustainability. Ongoing training with digital campaigns, interventions in public spaces is the way we have approached this challenge. The topics are varied, such as recycling, energy efficiency, water efficiency, healthy eating.

3.3.2 Thematic Inter-schools Sustainable Weeks

The efforts of the School of Economics and Business require partnerships with other schools of the University of Chile. Thus, joint activities have been conducted with the School of Agricultural Sciences, Forestry and Conservation, Veterinary and Animal Sciences, Physical Sciences and Mathematics, Social Sciences.

The week of sustainability was one of the activities developed in conjunction with the different schools, where relevant activities were conducted at each of the entities: urban planning and sustainability, energy and water resources and common interventions, urban pollution and health workshops orchard footprint measurement, among others.

Another activity held together is the "Bike Week", where the use of this transportation was promoted within the schools, and communication roads between schools were created as a result of the activity.

3.3.3 "El Mercadito" (The Little Market)

It is a fair of sustainable enterprises, open for the sale of products and the transfer of experiences of entrepreneurs to the university community, where we seek to encourage citizen participation spaces, the social economy, and creating environmental awareness. There is urgency to position businesses, products and/or services, as organizations with explicit responsibilities, analyzed and developed from their different angles and not just from the economic gains. Thus, that is what "The Little Market" promotes, a culture of entrepreneurship and sustainable education, an experience that helps to identify the balance between social, economic and environmental impacts; and finally promote initiatives of fair trade.

3.4 Line of Action in Research

EcoFEN research seeks to develop a contributions leading to the resolution of the challenge of sustainability, both in terms of title seminars, professional research and studies conducted by the unit.

3.4.1 Sustainable Development Index in Conjunction with the FEN and Acción RSE

The Sustainable Development Index (IDS) was calculated by FEN Academics in collaboration with Acción RSE. Is based on 10 million possible forms of asses the development of each country, ultimately trying this concept as a probabilistic object. It considers different ways of assuming the substitution or complementary between different dimensions of development, and presents each case separately. Ultimately, this research contributes to answering if possible, beyond the structure you set, say something about the levels and dynamics of sustainable development in different countries (Leiva et al. 2013).

3.4.2 Research Carried Out by Students and ECOFEN Volunteers

EcoFEN also promotes students to get involved in sustainability research projects. As until 2015, two major research projects were developed by students and volunteers.

Research: "Estimating the health costs of pollution by particulate matter in Chile" This paper seeks to identify the sources of particulate matter in Chile are and to estimate the economic health costs for Chilean society to have contaminated air. Through probabilistic functions, the number of cases of mortality and morbidity associated with particulate contamination is estimated. The results indicate that air pollution from PM10 has a considerable effect on the health, productivity and quality of life of people, bringing with it significant economic losses. In this sense, it is essential for regular Chilean society and oversee the actions that contribute to pollution, so as to improve the quality of life of Chileans and reduce costs associated with it.

Research: FEN Carbon Footprint Report 2012, 2013, 2014 Annual Comparisons of GHG Emissions The report consolidates all previous work on measuring carbon footprint for the years 2012, 2013 and 2014 applied via the GHG Protocol methodology. Corrected data and methodologies in obtaining information in order to reach a concluding analysis of how power has advanced through the years and still the essence of the methodology proposed from the beginning and to guarantee the essence of the method.

This seeks to correctly identify in which area the emission level is higher and which less. In conjunction with this consistency is achieved where it is really important to implement policies to reduce greenhouse gases that affect the overall footprint of this organization.

4 Conclusions: Implementing Sustainability in an Economics and Business School

After three years of existence of EcoFEN, and the Sustainable Campus project, it is important to perform exercises systematization and reflection on the achievements and opportunities for improvement to address the challenge of creating greater environmental awareness as an educational community.

In that sense, one of the first thoughts that arises is that one of the positive aspects of the teaching line of action is the existence of the social responsibility competence, whose definition is based on sustainable human development, that has largely not been achieved by other experiences, but "*few competences focus on the concept of SD, but many competences include partial elements of SD. Competences for SD are linked More Often With ethical and moral attitudes, and less Frequently With orientation system, future orientation, and action skills*." (Lambrechts et al. 2013)

Also, another positive aspect of the experience is the existence of a social internship. This is relevant, since most work-related experiences of sustainability in higher education focus on specific activities, but fails to connect them with the design of a course or a program (Figueiró and Raufflet 2015; Lozano et al. 2013).

Despite this, we have as challenge to measure the percentage of students achieving the expected standard of the Social Responsibility Competence that participated in a Social Internship or SD Courses. This has relevance not only in terms of ensuring the quality of education provided to our students, but could also make a contribution to other schools that are on this path, whereas according to the review by Figueiró and Raufflet (2015) no article in this paper reviewed aimed to contribute to assessing of both advancement of sustainability in management education as well as the assessment of learning.

Also, to carry out this type of initiative, it has-been crucial to work with the university community, especially students, in terms of the social inclusion interns and volunteers. Incorporating logical and sustainable habits, you cannot do without a participatory process of the community so that the results are permanent in time and point to a change in the institutional culture (Disterheft et al. 2015).

Accordingly with the systematization of actions and initiatives to promote SD, our biggest challenge is also clear: although we have made progress in terms of the line of action in research, one of our future challenges is to formalize a permanent line of research in sustainability in the School of Economics and Business Universidad de Chile, on the understanding "*the urgent need for sustainable development and the importance of research in this process, universities and their Researchers bear the major moral and responsibility to contribute to their research to sustainable development. They should consider this, moreover responsibility as a full part of the academic mission and not merely as an add on*" (Waas et al. 2010)

To do this, we consider an advance that the Management Department has founded 2015 Sustainability Observatory, which has associated academics interested in these issues. In that sense, a close link to the Observatory could help us promote a permanent line of research in sustainability and more academic interest.

References

Disterheft, A., Caeiro, S., Azeiteiro, U. M., & Filho, W. L. (2015). Sustainable universities—A study of critical success factors for participatory approaches. *Journal of Cleaner Production*, *106*, 11–21. doi:10.1016/j.jclepro.2014.01.030

ECOFEN. (2015). *Reporte Huella de Carbono FEN 2012, 2013, 2014*. Comparaciones anuales de emisiones GEI de la Facultad de Economía y Negocios, Universidad de Chile.

FEN. (2015). Orientador de Competencias Genéricas. Facultad de Economía y Negocios, Universidad de Chile.

Figueiró, P., & Raufflet, E. (2015). Sustainability in higher education: A systematic review with focus on management education. *Journal of Cleaner Production*, *106*, 22–33.

Lambrechts, W., Mulà, I., Ceulemans, K., Molderez, I., & Gaeremynck, V. (2013). The integration of competences for sustainable development in higher education: An analysis of bachelor programs in management. *Journal of Cleaner Production*, *48*, 65–73. doi:10.1016/j.jclepro.2011.12.034

Leiva, B. Vivanco, D, López, I. & Landerretche, O. (2013). "Hacia un Índice de Desarrollo Sostenible. Usando meta análisis y multidimensionalidad para ranquear la sustentabilidad de los procesos de desarrollo de los países. Facultad de Economía y Negocios, Universidad de Chile.

Lozano, R., Lukman, R., Lozano, F. J., Huisingh, D., & Lambrechts, W. (2013). Declarations for sustainability in higher education: Becoming better leaders, through addressing the university system. *Journal of Cleaner Production*, *48*, 10–19. doi:10.1016/j.jclepro.2011.10.006

Stephens, J. C., & Graham, A. C. (2010). Toward an empirical research agenda for sustainability in higher education: Exploring the transition management framework. *Journal of Cleaner Production*, *18*(7), 611–618. doi:10.1016/j.jclepro.2009.07.009

Universidad de Chile (2015) Decreto Universitario N° 0034852

University Senate. (2012). *University Sustainability Policy*. Universidad de Chile.

Waas, T., Verbruggen, A., & Wright, T. (2010). University research for sustainable development: Definition and characteristics explored. *Journal of Cleaner Production*, *18*(7), 629–636. doi:10.1016/j.jclepro.2009.09.017

World Commission on Environment and Development. (1987). *Our common future*. United Nations.

Author Biographies

Francisca Sandoval Gallardo Industrial Designer with post-graduate diplomas in Education for Sustainability (2013) and Sustainable Organization Management (2015). Current Coordinator of the Sustainable Campus program of the School of Business and Economics of the University of Chile, and associate professor at the University of Development in Public Responsibility. Professional member of the Sustainable Campus Network. Has experience in organizational strategic planning for sustainability, planning, the creation of cooperation networks and multidisciplinary collaboration, and the implementation of projects for a sustainable campus.

Beatriz Hasbun Held is graduated in Sociology (2010) and has a master's degree in Human Development at Local and Regional Level (2014). She is currently the Executive Director of the Teaching and Learning Center and the professor of the Social Environment Course at the School of Business and Economics of Universidad de Chile. Her current research interest includes Education for Sustainable Development, Innovation in Higher Education, Quality Assurance, and Advanced Human Capital. Participates in the Research Network of Chilean Education (RIECH). At the present time she is a LASPAU Fellow for the Spring 2016 semester, an organization affiliated with Harvard University.

Francisco García González is graduated in Business Engineer (2008) and bachelor's degree in Business Administration Science (2007) at Faculty of Economics and Business, University of Chile. He is currently the Head of University Social Responsibility at the same Faculty. Since 2012, he has been a Professor in Social Environment Course and has been researching the topics of social responsibility and sustainable development, both subjects at Faculty of Economics and Business, University of Chile.

Environmental Education in University Management: Contributions to Sustainability Construction at The University of São Paulo, Brazil

Marcelo de Andrade Roméro, Daniela Cássia Sudan, Ana Maria de Meira, Fernanda da Rocha Brando and Marcos Sorrentino

Abstract

The University of São Paulo/Brazil created in 2012 the Superintendence of Environmental Management (SGA-USP) aimed at linking existing actions and the construction of sustainability at the University. Faced with this challenge, the SGA invested efforts in the Project "environmental education of USP's technical and administrative staff", developed in order to provide insights that could allow the university's employees to expand their vision, perception and analysis of

M. de Andrade Roméro (✉)
Departamento de Tecnologia da Arquitetura, Faculdade de Arquitetura e Urbanismo, Universidade de São Paulo, São Paulo, SP, Brazil
e-mail: marcelo_romero@icloud.com

D.C. Sudan
Superintendência de Gestão Ambiental, Universidade de São Paulo, Ribeirão Preto, SP, Brazil
e-mail: danisudan@usp.br

A.M. de Meira
Superintendência de Gestão Ambiental, Universidade de São Paulo, Piracicaba, SP, Brazil
e-mail: ammeira@usp.br

F. da Rocha Brando
Departamento de Biologia, Faculdade de Filosofia Ciências e Letras, Universidade de São Paulo, Ribeirão Preto, SP, Brazil
e-mail: ferbrando@ffclrp.usp.br

M. Sorrentino
Departamento de Ciências Florestais, Escola Superior de Agricultura Luiz de Queiroz, Universidade de São Paulo, Piracicaba, SP, Brazil
e-mail: sorrentino.ea@gmail.com

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_26

their current status and entertain possibilities of socio-environmental intervention on their work and interaction spaces and thereby internalize sustainability in university management. The methodological framework of participatory-action-research in environmental education (EE) was adopted in the development of this initiative, with what's called the capillarity architecture system, through educating collectives called "PAP", level 1–4. The first project cycle was developed from March 2013 to October 2015 and involved about 2500 employees of all campuses of USP. The aim of this work is to present general results of this project as well as to discuss its challenges and potential in the training of civil servants focused on social-environmental sustainability. Those involved in the process include: 22 PAP1, who formed the project's managing group; 92 PAP2 who offered 31 courses to PAPs3; 533 PAP3 that promoted 127 interventions for 1853 PAP4 in different levels of content and workload (8–130 h of classroom training and monitored practice). This process brings contributions to the University environmental management, especially in community outreach; providing differentiated learning because of the requirement of practical interventions by all participants. It is expected that participation in this first cycle of environmental education leads to the effective participation of those employees in the university's environmental policies, which are under construction under SGA's leadership.

Keywords
Sustainability at HEI · Environmental education · Participatory approaches

1 Introduction

Environmental education is considered a fundamental principle for achieving sustainability in higher education institutions (HEI). The University plays a key role in this process by creating a socio-environmental agenda that permeates its structures, its daily activities and the development of its internal community, becoming thus an example for society (Tilbury 2011; Sudan et al. 2015).

In the early 21st century the "ACES project", a network of eleven universities from Latin America and Europe, started a large curricular greening process, aimed at sharing experiences from the "Programa de Ambientalización Curricular de los Estudios Superiores: diseño de intervenciones y análisis del proceso" (Environmental greening in higher education: intervention design and analysis of the process), financed by the European Union (ACES 2003). According to Ciurana and Leal Filho (2006), the ACES model provided innovative methodology that offers subsidies to processes of sustainability building in higher education. Those authors emphasize that, in order to achieve change in social habits, educational change that is lifelong and in all levels of education is needed.

A study developed by Brandli et al. (2015), presents a discussion about the main challenges facing the implementation of sustainability in Brazilian universities. They identified basically that the universities don't have institutionalized sustainability programs; they don't have programs to motivate their own teachers, students and staff; there's a lack of interest and knowledge about the subject; and usually the teaching, research and university management activities do not give priority to sustainability in their actions. The same authors point to the pre-conditions which are important for implementing sustainability: (i) investment in infrastructure; (ii) understanding the financial and environmental benefits of sustainability; (iii) that universities hold sustainability as an institutional commitment; (iv) that they provide staff education and training; (v) to involve all the university and outside community in a playful manner; (vi) that the State promotes public policies geared to the universities.

For Disterheft et al. (2015) there is a great number of papers about implementing sustainability in higher education institutions, but few of them investigate participatory approaches or use qualitative research. Their research suggests that participatory approaches aimed at the implementation of sustainability at higher education institutions (HEI) should consider, among other aspects, especially the level of participation, the group's composition, the appreciation of critical thinking, the exchange of experience and generation of new knowledge.

The incorporation of the social-environmental dimension should be present in all areas of the University and echo in the learning-teaching dimension so that the theories and practices established in it are not simply transmitted but built from traditional and scientific knowledge, individual and collective experiences (Freire 2013, p. 74).

Being the University a privileged space and having a great responsibility in the formation of professionals and the production of knowledge, it is its duty to develop processes that meet all of its activities. These activities include teaching, research, outreach and management (RUPEA 2007), aiming at the construction of "social values, knowledge, skills, attitudes and abilities" (Pavesi et al. 2006, p. 2) and can be geared towards sustainability at the University.

It is expected that universities start the greening process, with the incorporation of "environmental knowledge" in academic practices, leading to the construction of an "environmental rationality" of the institution and in its community (Leff 2007). Incorporating environmental education at the University, through permanent and continuous educational processes may contribute to: (i) educate the institution itself, so that it incorporates environmental issues in its daily life and in all its activities; (ii) collaborate with the elaboration of environmental education public policy for society (Sorrentino et al. 2011, p. 21).

The University of São Paulo (USP), a community of about 120,000 people spread across multiple campuses in the capital and in the State of São Paulo (Brazil), plays an important role in advancing teaching, research and outreach

projects in Brazil. Its actions have insertions in other institutions and inspire models of social action.

In 2012, the USP created the Superintendence of Environmental Management (SGA-USP acronym in Portuguese) which aims to articulate the various outreach, research, teaching and management initiatives in the environmental field and seek sustainability for the University itself (USP 2016). In 2013, the SGA-USP started an employee environmental education process, having as partner the USP School of Management, which is linked to the University's administration. It has also received support from local campuses administrative offices and units of seven USP campuses: the cities of Bauru, Lorena, Piracicaba, Pirassununga, Ribeirão Preto, São Carlos and São Paulo (Meira et al. 2014; Sudan et al. 2015).

The "Environmental Education of USP's technical and administrative staff" has amongst its aims providing theoretical and practical repertoires so that USP's employees may expand their vision, perception and analysis of their current status and entertain possibilities of socio-environmental intervention on their work and interaction spaces.

The aim of this paper is to present and discuss the main results of the educational process and the implications of this study in the implementation of socio-environmental sustainability at the University. The challenges and potential in the education of civil servants focused on socio-environmental sustainability will be discussed, which may contribute to other universities who are following the same path.

2 The Employees' Environmental Education Process and Methodological Aspects

The SGA-USP understands that the entire university community should participate in building a sustainable university and thus has promoted several initiatives in this regard. In the environmental education mentioned above the technical and administrative staff was initially chosen, seeking to promote the internalization of the principles of sustainability in the university management. This public, coming from seven USP campuses, consists of approximately 16,000 employees from diverse sectors and working areas.

Seeking to involve all this target group in the development of the project the methodological framework of participatory-action-research in environmental education was adopted, with the capillary system and the action of collectives of environmental educators called "PAPs"—people who learn by participating, inspired by a federal public policy started in Brazil in 2005 aimed at the formation of environmental educators (Brasil 2006).

Each PAP (the acronym in Portuguese is used in its original form in this article because of its resonance) involved in the process had access to:

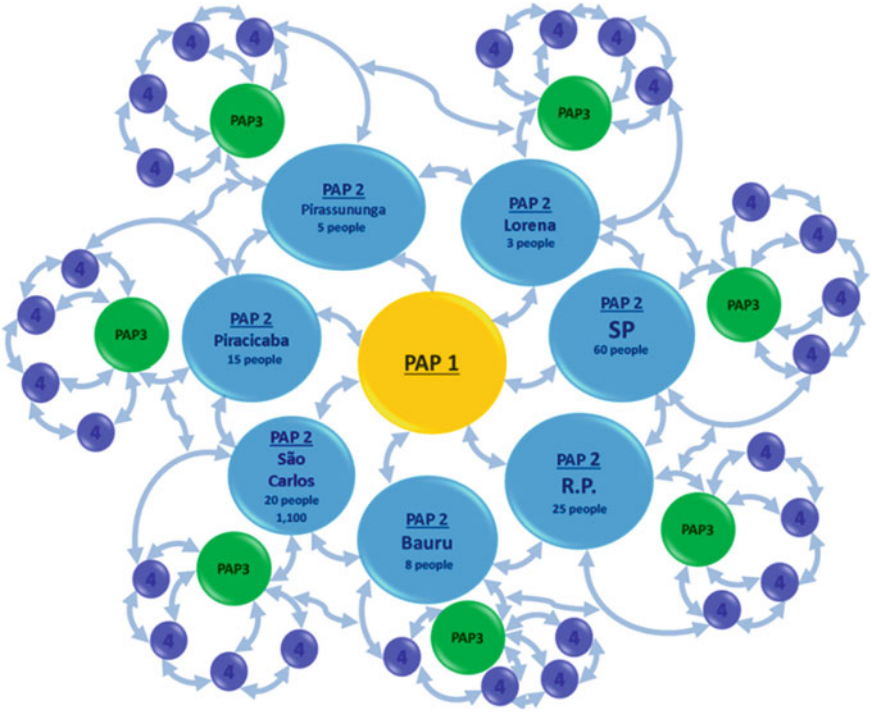


Fig. 1 Schematic representation of the capillary architecture of the Project "Environmental education of USP's technical and administrative staff" of USP/Brazil (Sudan et al. 2013)

- Conceptual Repertoire—involving the treatment of a range of information in four modules: (a) socio-environmental crisis and sustainability, (b) environmental management, (c) educommunication[1] and (d) environmental education;
- Situational Repertoire—learning to conduct participatory environmental diagnoses in their units and,
- Operating Repertoire—since each PAP has to develop a sustainable educating practice in the workplace, bringing positive impacts on education and university management (Sudan et al. 2013).

The educational process' capillarity system (Fig. 1) is something unique in Brazilian universities, given its degree of demand in protagonism from the employees and of the rooting of environmental education in the institution.

> The Superintendent of Environmental Management [SGA-USP] and the Group for Research and Studies on Environmental Education were included in the capillary network

[1]Educommunication means linking education with communication by the creation of communication materials in various formats with educational purposes, such as radio or television programs or newspapers.

> as a PAP-1 collective educator (25 people), playing the role of developing the political-pedagogical project and creating and monitoring (on-site and at a distance) a group of agents and commission members, the PAP-2s (135 people). The latter are committed to teaching courses at their workplace to PAP-3s (4590 people), and the PAP-3s are in turn committed to developing educational action connected to environmental management, and involving other public workers (the PAP-4s), implementing the education of a total of 17,000 people with different levels of knowledge regarding the environment (Sudan et al. 2013; p. 3).

In March 2013, the SGA's technical team took over the executive coordination of the project, moderating meetings of Group for Research and Studies on Environmental Education, with experts invited from inside the institution.

This Group had the mission of collaborating in the proposal's design and assisting in the coordination and implementation of the project on the USP campuses. At each campus a support team, including culture and extension scholarship —receiving students and internships funded by the proponent agency was created. To support SGA's technical staff in coordinating actions some temporary contracts for educational services were signed, for a period of three months, as follows: 2 educators on the Pirassununga campus; an educator in Ribeirão Preto; 2 educators in São Carlos and two educators in Piracicaba.

Throughout the project's development, several professors from all campuses were involved as coordinators of the educational process, as project mentors or even as guest speakers called upon to present and discuss together with the employees topics relevant to sustainability (Sudan et al. 2013).

2.1 Composition and Activities of the PAP1 Group

This Group was formed upon a SGA-USP invitation in March 2013. Taking into consideration the expertise in the socia-environmental area, some professors and technicians from the USP campuses were invited to compose the Group for Research and Studies on Environmental Education, responsible for coordinating the development of the proposal for the social-environmental education of USP employees. Between March 2013 and February 2015, the Group met about 30 times to plan, evaluate and enable the project's activities, receiving certification of 200 h by SGA-USP and USP School of Management for their performance.

During this period, the PAP1 developed some actions aimed at institutional articulation that would enable the project's development on campuses such as:

- Presentation of the educational project at the university's decision-making spheres, in management councils (directors and campuses' mayors) in Bauru (Nov 14, 2013), Pirassununga (Sept 16, 2013), São Carlos (Oct 17, 2013), Ribeirão Preto (Dec 04, 2013) and Piracicaba (Oct 17, 2013).
- Handling communications with the units' heads and directors asking them to nominate/select the PAP2 (professionals experienced in the environmental area) on campuses.

- Organization and follow-up of the meetings with the new PAPs on campuses and two meetings among various campuses.
- Setting mentoring of the PAP2 projects.

Eight extension fellows, six interns and five educators were hired to work on the project and support PAP1 in their own campuses.

2.2 Composition and Activities of the PAP2 Group

The PAP2 group was formed according to the experience in the socio-environmental area. To this end, PAP1 and campuses' leaders appointed around 150 employees that had already coordinated or coordinate commissions related to the environment (waste management, disease vectors, environmental ethics, and work safety, among others already established in the university) and/or work as professionals specialized in worker safety, waste management, environmental education on the campuses. After getting the approval of their superiors the employees were invited to learn more about the project and join the proposal with a formal enrollment.

Between December 2013 and June 2015, the PAP2 gathered to plan, evaluate and enable the project's activities, receiving certification of 130 h by SGA-USP and USP School of Management for their performance.

During this period, the PAP2 participated in various training activities, such as:

(A) **Reports, plans and communications elaboration**

- Filling forms of declaration of interest and registration of PAP2, containing data such as name, function, interest in the socio-environmental theme and the course.
- Data logging in the PAP2 model monitoredactivity practice Form containing description of activities, workload etc.
- Execution and data registration of preliminary socio-environmental diagnosis containing key issues, initiatives, potential, campus gaps in the environmental area.
- Participation and preparation of reports from the Pirassununga meetings of 2013 and 2014 (see item B);
- Partial evaluation of project development and formations among various campuses;
- Development of posters (37 in total) presented in event among various campuses, related to the projects these PAP2 would develop with the PAP3;
- Preparation of the social-environmental educational intervention plan drawn up by the PAP2 with support from tutors (PAP1 and other faculty) on campuses.

(B) **PAP2's educational process**

After one year of participation in educational meetings, the PAP2 started developing educational interventions (that would be carried on with PAP3 employees) working in sub-groups. Those sub-groups were organized based on affinity for a theme or because participants could develop their intervention in the same unit. The PAP2 were tutored by PAP1 at this stage. The tutoring occurred both in private meetings, when initial intervention ideas where discussed, further reading materials were proposed and review of the courses' plans were performed; or in group meetings involving participants from various campuses, through activities in which the PAP2 wrote and reported their initial ideas for their projects, shared experiences and heard suggestions from colleagues. Each project was reviewed considering the repertoires provided in the Project: conceptual, situational and operational, besides the existence of adequate theoretical support.

Regular classes with the PAP2 on each campus of origin occurred during the whole educational process, comprised of 40 h of classes, including 18 h of lectures and participatory experiences addressing contents of participatory methodologies, environmental mapping, environmental management, educommunication and study seminars.

Group meetings involving PAP2 from various campuses PAP2 were also organized, lasting 20 h each, in December 2013 and December 2014, discussing the subjects of civilization crisis and sustainability, climate change, cultural industry and consumerism, public policy, good sustainability practices in universities and the basis of environmental education. The topics were presented and discussed in different ways such as lectures by experts from USP and other higher education institutions and round tables, culture activities and art education. The meetings allowed the establishment of relationships among various campuses and produced rich experiences to participants and motivation for facing similar issues and initiatives between the USP campuses.

At this event (Dec/2014) 37 posters of the PAP2 with the plans for the courses that they prepared for the PAP3 were presented (Table 1).

Besides the traditional in-person classes the PAP2 conducted practical monitored activities with a 60-h workload, such as assigned readings; conducting preliminary social-environmental diagnosis in the units; mentoring meetings, preparation for the intervention with the PAP3, resulting in 31 courses effectively conducted with the PAP3 (of the 37 initial proposals, as some courses were merged), as shown in Table 1.

2.3 Composition and Activities of the PAP3 Group

This group was formed in March 2015. The process of staff participation occurred through online subscription on the project site. Each PAP3 could choose the course of greater interest. We chose not to assign employees to specific courses, but rather leave enrollment open, offering large numbers of spots so participants could pick

Table 1 List of the posters' themes prepared by the PAP2 showing the course plans prepared for the PAP3

Themes		Course title	Campus
Water	1	Water: shortage risk	Ribeirão Preto
Water and waste	2	Water and waste in the formation of an environmental identity of USP Luiz de Queiroz campus staff	Piracicaba
Consumption	3	Sustainable purchases: reflections on the acquisitions of goods and services with PUSP-RP technical and administrative staff	Ribeirão Preto
	4	Education for sustainable consumption and waste management at the USP São Carlos campus units EESC, ICMC, CDCC and PUSP	São Carlos
	5	Education for sustainable consumption and waste management at the USP São Carlos campus units DTI, IAU, IFSC, IQSC	São Carlos
	6	Consuming at the USP	São Paulo
Educommunication	7	Video—reflection and environmental action	Ribeirão Preto
Environmental management and education	8	Educommunication for environmental sustainability at the USP São Carlos campus	São Carlos
	9	Continuing environmental education in the formation of the campus Luiz de Queiroz/USP staff: "Education for sustainability"	Piracicaba
	10	Educating for change: The environmental scenario in the USP Bauru campus	Bauru
	11	Participant-action-research: a sustainable look at water, energy and physical space on the USP Bauru campus	Bauru
	12	An awakening to social and environmental aspects of staff's day-to-day…	Piracicaba
	13	Ecological trails—an environmental outlook on the Pirassununga campus	Pirassununga
	14	"Sustentare Course": the value of a sustainable environment today and tomorrow. PAP3—SGA—USP project	Ribeirão Preto
	15	Pathways to a Sustainable University	Ribeirão Preto
	16	Education in sustainability for the reflection and action of FCFRP/USP staff	Ribeirão Preto
	17	The "reform of thinking" as a way of raising awareness and sensibilization in environmental education	São Paulo
	18	Awareness and sensitivity—art and educommunication for sustainability	São Paulo
	19	Sensitization to belonging to USP as a stimulus for action on sustainability and environmental education	São Paulo

(continued)

Table 1 (continued)

Themes		Course title	Campus
Laboratories	20	Sustainability at campus "Luiz de Queiroz" laboratories	Piracicaba
Mobility	21	Reflecting on mobility in the USP-São Carlos Campus 1: alternative routes and new paths	São Carlos
Pollution	22	Pesticides: uses and hazards to health and to the environment	Ribeirão Preto
	23	Environmental pollution: what does this have to do with me?	São Paulo
Residue	24	Reagents bank	Ribeirão Preto
	25	Reject yes, residue no!	Lorena
	26	Clean environment, living environment	São Paulo
	27	Chemical residue management at the Pirassununga campus: Information, Identification, Storage and Disposal	Pirassununga
	28	Socio-environmental participation in waste management through the treatment of fluorescent lamps and electro electronics exemplification	São Paulo
Sustainability in administration	29	Sustainability's role in the administration field —"Luiz de Queiroz" campus	Piracicaba
	30	Sustainable leadership education—rational use of paper at the Pirassununga campus	Pirassununga
Land use	31	Mapping of the weaknesses and potential of the USP São Carlos campus 2 natural areas	São Carlos
	32	Building the future—sustainable buildings	São Carlos
	33	Land use and occupation on "areas 1 and 2" São Carlos campus	São Carlos

and choose the courses. Their enrollment had to be acknowledged and authorized by their immediate superiors. This procedure was adopted so that the employee could participate in the courses during working hours with institutional support.

Between March 2015 and June 2015, PAP3 participated in 20 h of classroom training involving the various socio-environmental issues listed in Table 1, through lectures, technical visits, group dynamics, developed by PAP2 and experts invited from the institution, including professors.

The PAP3 had 12 h available to plan and prepare an intervention plan for the PAP4, under the mentoring of the PAP2.

The PAP3 conducted 8 h of educational interventions with other groups called PAP4, following the same principles.

PAP3 have been certified by the USP School Management for 40 h of work.

2.4 Composition of the PAP4 Group

From June 2015 to October 2015, educational activities for PAP4 groups were developed. Participation in this group was available through direct enrollment with PAP3 or at the time of the activity. A total of 120 environmental educational interventions in all campuses of the USP were developed.

Most interventions have involved practical activities, videos exhibition and debate, technical visits, conversation circles, among other educational activities, that led stakeholders to reflect on the importance of sustainability at the university.

These participants have been certified 2–8 h of activity by the USP School Management. Each PAP4 could participate in as many interventions as desired, as long as authorized by their immediate superiors.

2.5 Communication

The communication of the project was organized in view of its educational dimension, guided by the goal of contributing to a change of organizational culture from socio-environmental values (Sudan et al. 2015) and to serve society as a reference by their actions and example.

During the training process various communication channels with the staff participating in the project and the USP community have been developed, among which we would like to highlight:

- Disclosure of the initiative in the USP media;
- Production of a release video by SGA: https://www.youtube.com/watch?v=GVcomAhrskQ
- Production of a release video by IPTV: https://www.youtube.com/watch?v=Eh_CcxnZIbg
- Visual identity development and website the Project "environmental education of USP's technical and administrative staff": www.educacao.sga.usp.br
- The opening and maintenance of a Digital Interaction Platform for participants: in January 2014 the Moodle platform was established, in order to enhance the communication process of the project, facilitating the availability of materials, dissemination of issues related to the Project and, besides that, to be used as a tool for any future demands of Online/Distance Education.

The Group for Research and Studies on Environmental Education also developed a plan to build the visual identity of the project producing a logo (Fig. 2) and subsequently developing a digital platform to host the actions and media of the training process. The logo development involved the proposition of several versions considering some criteria for their production such as: "something that could express team spirit", "that did not involve the traditional trees used in environmental education", that brought the idea of "people", "of capillarity", "of an horizontal multiplier process", "of education". The design's image, which refers to the

Fig. 2 Logo of the project "environmental education of USP's technical and administrative staff"

shape of a mandala, a flower or stained glass was inspired by the design of the diagram (Fig. 1) and brings together concepts such as group of people, diversity, internships, integration, development, capillarity, growth and propagation (Martirani et al. 2015).

2.6 Project Evaluation

Seeking a better understanding of the socio-environmental training of USP employees, from the perspective of members of various groups of PAPs some evaluative documents were organized, as follows:

- PAP2 were asked to evaluate the two Pirassununga events (Dec, 2013 and Dec, 2014); the project (partial evaluation, answered by PAP2 in Dec, 2014, in the format of an individual questionnaire); partial assessments of specific activities in each campus; online individual final assessment (*Google* doc form)
- PAP1 filled individual evaluations offered during a group meeting (August 13, 2015, Pirassununga campus);

Analyses of these assessments are still ongoing.

3 Results and Discussion

Considering the conceptual, situational and operational repertoires, as well as the capillarity method shown above, the data discussed below is the result of both quantitative and qualitative analysis of activities, which took place in a dynamic way, in concrete situations in the participating staff's workplaces.

Between 2013 and 2015, the Project "environmental education of USP's technical and administrative staff" involved about 2500 employees of all USP campuses. Some data from this first cycle will be presented and discussed below considering the educational process and the work of the four groups/levels of PAPs (PAP1-PAP4), the strategies and actions triggered and necessary for the development of the process as well as a general evaluation of its development.

(A) **Involved in the process**: 22 PAP1, who formed the steering group of the project; 92 PAP2 who conducted courses to PAP3; 533 PAP3 that promoted interventions for 1853 PAP4 in different levels of content and workload (8–130 h of classroom training and monitored practice). Several institutional linkages were carried out with the leaders and some integration bodies, including the authorization of participant involvement by their superiors.
(B) **Promotion of courses on socio-environment**: 31 classroom courses of short duration (40 h) were promoted simultaneously by the PAP2 on campuses, in the first half of 2015.
(C) **Socio-environmental practices in each campus**: 127 simultaneous education and environmental management activities on campuses were offered to PAP4 (from June to October 2015).
(D) **Publications, educational materials and visual productions**: In addition to the website and the virtual platform, the organization of a written, bilingual publication, is under way in order to disseminate the experience and results of the process.

The "environmental education of USP's technical and administrative staff" Project first cycle of activities was concluded at the end of 2015. This process lasted more than two years (March 2013–December 2015) and its continuation is in the process of being evaluated and improved.

Throughout the process it was possible to raise, together with the groups involved, in particular the PAP2 group, a list of some needs and difficulties that need to be addressed to improve the process, such as:

- The need for a deeper understanding of some of environmental education and environmental management concepts;
- Insecurity of PAP2 in the development and promotion of courses;
- Greater support to the actions of PAP in some units;
- Difficulty of overcoming traditional models of education;
- Being able to keep participants engaged until the end of the process (some of the participants withdrew due to a variety of motivations and to the voluntary resignation plan of the university, promoted during the project implementation period);
- Lack of infrastructure and funding for the implementation of some planned actions.

As major advances, we can list:

- Overcoming the PAP2 expectation of having to execute projects that came "pre-set" (by the PAP1) to solve their local problems,
- Increased sense of belonging to the university community;
- Theoretical deepening that enabled changes on the outlook on the relationships between human beings and the environment;
- Among the learning identified by the participants stands out specific knowledge about the social context—on the participating subjects, their personalities, ideals, values, characteristics and relationships—as well as the organizational structure of the University and its internal dynamics.
- Among the scientific-academic knowledge are those related to the different contents addressed in the process, related to environmental management, education, society, culture, psychology and social action;
- Conciliation between academic research activity and the process of environmental education;
- Involvement of employees from various functions and leadership positions;
- Recognition by the university community of the importance of this process' continuity (Sudan et al. 2015).

As this educational process is under way, the country goes through a recession period and the USP suffers structural changes, so it is important to register the continuity of many USP employees involvement with this theme. There are signs of a commitment to environmental issues, which can be observed in the interest in the classes offered, in participation and decision making processes related to the university's search for socio-environmental sustainability.

The involvement and participation of employees at the university's conservation actions, promotion of educational courses, socio-environmental practices and the ensuing publications offers a counterpoint to alienation and distancing to the care of the common good, which are essential to achieving socio-environmental sustainability.

The participation of the USP in national and international networks has shown the importance of sharing innovative experiences such as the ones related in this paper, that can stimulate other experiences of enhancement of the educational and environmentalist "doing" of higher education institutions.

4 Final Considerations

This process brings contributions to environmental education in university management by providing differentiated learning due to the requirement of practical interventions by all participants, expanding the integration between staff and knowledge of the functioning of environmental management at the university.

The capillarity system allowed expanding the network of participants, mainly at levels 1, 2 and 3. It is noteworthy that the employees that went through the training process, according to PAP1 perception, have sought to engage in commissions and activities related to environmental issues, showing a greater depth in their discussions and in the preparation and implementation of sustainability initiatives at the university. Therefore, it is expected that these employees will have an effective participation of in the USP Environmental Policies that are under construction.

The environmental education process constituted an innovative and challenging experience within the Brazilian Universities, mainly for its participatory dimension, of empowerment and autonomy of those involved.

The training at different levels of involvement and workload brought direct contributions to the environmental management of USP, with interventions in University structures.

Among the main actions aimed at environmental management of the university community, we highlight the recovery of campus areas with replanting seedlings in devastated places; rescue of the nature trails in the campuses; training on the use of agricultural inputs; pilot project development for reuse of water; implementation of a rainwater collection system; deployment of an air conditioning water reuse system; pilot system of evaluation of chemical reagents and laboratory materials bank; actions to improve the management of electronic waste; awareness of better use of cleaning products and reagents; contribution to organizational and operational changes in the sectors and departments; training and certification laboratory, as well as general awareness for the development of actions for green purchasing, sustainable mobility etc.

In addition to direct contributions to the environmental management of the campus, it was found that the biggest gain was the involvement and connectedness of staff and educating processes shared by them and the construction of autonomy with respect to activities and discussions on topics of environmental education.

It is expected that this process, coupled with the USP Environmental Policies that were developed by the SGA-USP, can contribute to the internalization of environmental sustainability at University.

Acknowledgments This study presents a collective project by the University of São Paulo, and, therefore, we thank all the other members of the Group for Research and Studies on Environmental Education who were unable to participate in the production of this article, though they have been collaborators in the Project of Environmental Education of technical and administrative USP employees since 2013.

References

ACES Network. (2003). *Ambientalizacion Curricular de los Estudios Superiores*. http://insma.udg.es/ambientalitzacio/web_alfastinas/castella/c_index.htm (Last Accessed March 11, 2016).

Brandli, L. L., Leal Filho, W., Frandoloso, M. A. L., Korf, E. P., & Daris, D. (2015). The environmental sustainability of Brazilian Universities: Barriers and pre-conditions. In W. Leal

Filho et al. (Ed.), *Integrating sustainability thinking in science and engineering curricula* (pp 63–74). World sustainability series. Switzerland: Springer International Publishing.

Brasil. Ministério do Meio Ambiente. (2006). Programa Nacional de Formação de Educadoras (Es) Ambientais por um Brasil educado e educando ambientalmente para a sustentabilidade. Série. Documentos Técnicos. http://www.mma.gov.br/estruturas/educamb/_arquivos/dt_08.pdf. (Last Accessed January 25, 2016).

Ciurana, A. M. G., Leal Filho, W. (2006). Education for sustainability in university studies. *International Journal of Sustainability in Higher Education*, *7*(1), 81–93. doi:10.1108/14676370610639263. (Last Accessed March 11, 2016).

Disterheft, A, Azeiteiro, U. M., Leal Filho, W., & Caeiro, S. (2015). Participatory processes in sustainable universities—What to assess?, *International Journal of Sustainability in Higher Education*, *16*(5), 748–771. doi:10.1108/IJSHE-05-2014-0079. (Last Accessed March 11, 2016).

Freire, P. (2013). Pedagogia da Autonomia. Paz e Terra, 45ª edição, São Paulo, Brasil.

Leff, E. (2007). *Epistemologia ambiental*. São Paulo, Brasil: Cortez.

Martirani, L. A., Brando, F. R., & Baccarin, L. M. (2015). Formação Socioambiental dos Servidores da USP e o Projeto'Sustentabilidade é…'." In: III Congresso Internacional de Educação Ambiental dos Países e Comunidades de Língua Portuguesa (2015), Torreira, Murtosa. Livro de resumos. Comunicações Orais, Associação Portuguesa de Educação Ambiental (ASPEA), Torreira, Murtosa, pp. 438–439.

Meira, A. M., Bonzanini, T. K., Rosa, A. V., Ometto, A. R., Gois, C. C., Cunha, D. G., et al. (2014). Socio-environmental formation in capillarity to employees of Universidade de São Paulo [University of São Paulo] / Brazil" In: VI Conferência Internacional de Educação Ambiental e Sustentabilidade, 2014, Bertioga - SP. Proceedings 6th International Conference on Environmental Education and Sustainability. São Paulo. Brasil, pp. 457/467. www.sescsp.org.br/conferenciabertioga (Last Accessed December 23, 2015).

Pavesi, A., Farias, C. R. O., & Oliveira, H. T. (2006). *Ambientalização da Educação Superior como aprendizagem institucional*. Paraná, Brasil: Com Scientia Ambiental.

RUPEA. Rede Universitária de Programas de EA para Sociedades Sustentáveis. (2007). Órgão Gestor da Política de Nacional de Educação Ambiental. Mapeamento d Educação Ambiental nas Instituições Brasileiras de Ensino Superior: elementos para políticas públicas. Brasilia. no. 12. Documentos Técnicos. http://portal.mec.gov.br/secad/arquivos/pdf/educacaoambiental/dt12.pdf. (Last Accessed January 15, 2016).

Sorrentino, M., Nascimento, E., & Portugal, S. (2011). Universidade, educação ambiental e políticas públicas, in Leme, P. C. et al. Visões e Experiências Ibero-Americanas de Sustentabilidade nas Universidades 2011, Desdobramentos do 3º Seminário Internacional. São Carlos, São Paulo, Brasil, pp. 19–27

Sudan, D. C., Meira, A. M., Bonzanini, T. K., Rosa, A. V., Gois, C. C., Cunha, D. G., et al. (2013). Projeto Político Pedagógico de formação de servidores técnico-administrativos da USP. Universidade de São Paulo. Superintendência de Gestão Ambiental da USP. São Paulo. Brasil

Sudan, D. C., Meira, A. M., Sorrentino, M., Rocha Brando Fernandez, F., Silva, R. L. F., Martirani, L. A., et al. (2015). Environmental education for staff at the University of São Paulo, Brazil: Capillarity and critical environmental education put into action. In W. Leal Filho, U. M. Azeiteiro, S. Caeiro, & F. Alves (Org.), *World sustainability series* (Vol. 2, pp. 543–558). Switzerland: Springer International Publishing.

Tilbury, D. (2011). Higher education for sustainability: A global overview of commitment and progress. Higher Education's Commitment to Sustainability: From Understanding to Action. England.

USP. (2016). Universidade de São Paulo. Superintendência de Gestão Ambiental da USP. Objetivos e missão da SGA. http://www.sga.usp.br (Last Accessed January 18, 2016).

Authors Biography

Marcelo de Andrade Romero Holds an undergraduate degree in Architecture and Urbanism, specialist in Philosophy and Philosophy Teaching, Master of Environmental and Urban Structures and PhD in Renewable Energy and Environmental and Urban Structures. He is Full Professor of the University of São Paulo (USP), Faculty of Architecture and Urbanism. Director of the USP School of Architecture and Urbanism from 2010 to 2014, currently Member of the International Union of Architects UIA—WP Architecture for a Sustainable Future Group. He is Superintendent of the Environmental Management Superintendence and Dean of USP's Culture and Extension.

Daniela Cassia Sudan Holds an undergraduate degree in Biological Sciences, Master's of Education and is currently a doctoral student in Education at UFSCar/Brazil. She has been an Environmental Educator at USP since 2001. Has experience in the field of Environmental Education and shared management and minimization of solid residue, educators collective s and the educating of new environmental educators.

Ana Maria de Meira Holds an undergraduate degree in Forest Engineering and a Teaching Degree in Agricultural Sciences; Master of Forest Sciences and PhD in Science from the University of São Paulo. Works as an Environmental Educator at USP. Has experience in Waste Management, Environmental Planning, Environmental Education and Forest Resources.

Fernanda da Rocha Brando Holds an undergraduate degree in Biological Sciences; a specialist degree in Environmental Management; Master's and PhD in Science Education. Teaches in the Department of Biology at USP's Faculty of Philosophy, Sciences and Letters in Ribeirão Preto and coordinates the Epistemology and Biology Teaching Laboratory. Participates in teaching, research and outreach projects in the area of environmental education and sustainability.

Marcos Sorrentino Holds an undergraduate degree in Education and one in Life Sciences; Master's and PhD in Education. Professor and environmentalist. Teaches since 1988 at the Department of Forest Sciences, ESALQ/USP and coordinates the Education and Environmental Policy Laboratory. Director of environmental education of the Brazilian Ministry of the Environment from 2003 to 2008.

A Peer-to-Peer Approach to Evaluation and Continual Improvement of Sustainability Management Systems at Higher Education Institutions

Markus Will, Anke Zenker-Hoffmann, Jana Brauweiler, Bernd Delakowitz, Stefanie Herbig, Andreas Bulçu and Eric Schön

Abstract

Background Up to now, quality and environmental management systems are usually evaluated by means of an internal and external audit. Although auditors are expected to have certain competencies, such personal attributes, expertise, experience and skills, the audits typically end up in a costly and bureaucratic exercise. The possibility of making use of the wisdom, tacit knowledge and the critical views of practitioners, i.e. sharing best practices, asking thought-provoking questions and providing support for each other based on a common professional experience, is mostly not a specific aspect of an auditing procedure. *Objective* To provide a concept to sustainability managers at Higher Education Institutions focussing on collegial dialogue by peer-to-peer audits The focus is not limited to external, evidence-based performance assessment but pays attention particularly to improvement and organisational learning by proving a framework for collegial dialogue under peers. *Methods* The concept was derived from a literature review and is a result of a joined project work based on several years of professional experience in the field of environmental management systems and sustainability. *Results* The paper characterizes peer-audits and provides detailed guidance on quality requirements, organisation and coordination as well as how a peer-review audit programme could be conducted within a 3-step approach.

Keywords

Sustainability audits · Peer-to-peer · Campus sustainability

M. Will (✉) · A. Zenker-Hoffmann · J. Brauweiler · B. Delakowitz · S. Herbig · A. Bulçu · E. Schön
Environmental Management Team, University of Applied Sciences Zittau/Görlitz, Theodor-Körner Allee 16, 02763 Zittau, Germany
e-mail: m.will@hszg.de

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_27

1 Introduction

1.1 Towards True Sustainability of Universities

There is a lively discussion about the role of universities in sustainable development, about education for sustainability and sustainable campus management for more than 20 years now. Impressively, more than 600 global HEI have committed them towards sustainability (Leal 2011). Activities mostly focus on campus operations, i.e. reducing environmental impacts at the site and, which is challenging enough, the integration of sustainability aspects in curricula and research programmes (Anand et al. 2016). However, a fundamental paradigm shift, in terms of mainstreaming and additionally taking into account the role of HEI as agents for change (Chambers and Walker 2016), in not in sight yet (Wals 2012; Tilbury 2012; Disterheft et al. 2013). Many institutions are facing situations that hamper a full implementation (Raskin 2012; Lozano et al. 2013). Furthermore, universities are expected to rigorously take responsibility for playing a more central role in the sustainable development of modern knowledge-based societies (Schneidewind 2014; Schneidewind and Singer-Brodowski 2014). It is especially the reflexive capacity which makes universities a key agent in large-scale social and cultural change (University Hamburg 2013). This enhanced responsibility assumes a sound management of own activities ("walk the talk by campus greening"), conscious and actively promoted orientation of teaching and research, i.e. taking grand global challenges (European Commission 2011) as starting point for designing transdisciplinary research programmes (Will and Rydén 2015) with the participation of non-academic stakeholders.

1.2 Limitations of Conventional Audits

Although external, third-party audits have been a long-lasting procedure in the industry since the uptake to ISO 9000 and ISO 14001 standards, the value of the audit process is more and more questioned (Kluse 2013; Sayle 1995; Sayle 1999; Gordon 2001; Dalgleish 2006). Although auditors are expected to have certain competencies, such personal attributes, expertise, experience and skills, the audits typically end up in a costly and bureaucratic exercise. Especially for mature organizations, external auditing fails to add tangible value. The continued audit cycle, that is annual surveillance audits and periodical re-certification audits, are redundant. Several studies (ibid.,) and practical day-to-day experiences of environmental managers give the impression, that organizations are pressured to conduct audits to maintain the status of certification or validation but there seem to be diminishing value in terms of process improvement. The certification process is seen as flawed (Sayle 1995) and the certificate as an expensive but meaningless paper (Gordon 2001). Although there is little doubt that external audits are appropriate tools for independent, objective and systematic evaluation against

standards and requirements, they mostly fail in enabling continuous improvement process (Karapetrovic and Willborn 2000, 2002). However, the actual and genuine purpose of PDCA-alike-management systems lies exactly in substantially improving the state-of-performance and not merely the verification of compliance with agreed-upon standards.

Enabling improvement and organizational learning rely on the possibility of making use of the wisdom, tacit knowledge and the critical views of practitioners. Mutual learning and knowledge sharing, i.e. sharing best practices, asking thought-provoking questions, discuss no-goes and providing support for each other based on a common professional experience, is key to continuous improvement. However, this is mostly not a specific aspect of an auditing procedure. Organizational learning, i.e. creating and retaining innovative ideas based on practical experiences, enables organizations to effectively increase their organizational behaviour (Senge 1990) and their sustainability performance.

To better understand the limits of conventional external auditing processes, it is necessary to relate to changes that are occurring in the organizational world. Edgar Schein summarizes theses changes as a set of propositions (Schein 1993), that also apply for HEI. Such propositions are for example the increasing dynamic and rate of change in the organizational context (environment), the growing technical complexity, the trend to knowledge-based informational networks. Organisational effectiveness is, therefore, dependent on valid communication across subcultural and epistemic boundaries and requires an overarching common language and shared mental models, for example about the new role of HEI in society (WBGU 2011; Schneidewind 2014). However, the "*evolution of new shared mental models is inhibited by current cultural rules about interaction and communication, making dialogue a necessary first step in learning*." (cit. Schein 1993). A structured and effective dialogue creates new possibilities for valid communication in groups and is increasingly important for creative learning processes, problem-solving and improvement.

Peer-to-peer audits may be considered as a value-creating instrument that fosters effective dialogue and continuous improvement in addition to audits that concentrate on conformity with management standards. In this paper, guidance is provided to understand and prepare peer-to-peer audits. Starting with a definition of peers and a description of expected benefits (Sect. 2), and a characterisation of the procedure (Sect. 3), conclusions will be drawn at the end of the text.

2 Characterisation of Peer Audits

2.1 What Is a Peer?

A peer group consists of a number of people, who belong to the same or similar societal group (based on age, grade or status) and who are connected by some

shared activity or interest.[1] Peers are companions. A peer is considered as being independent but coequal with the persons "under review", i.e. representatives of an organization or persons in charge. Examples for peers, despite hierarchical differences, in the context of HEI are:

- Professors and lecturers, other academic staff members
- Students
- Environmental or EHS-Managers, sustainability change agents
- Representatives of administration department.

2.2 What Is a Peer-Review?

In the context of quality management of health care and medical providers, where the concept is known and largely applied, a peer review is a structured approach to continuously and critically reflect (medical) activities, organizational processes and colleague's performance by means of professional dialogue (BÄK 2013: 15; Grol 1994). A peer review is literally an evaluation by a colleague. Especially physicians have been doing peer audits for a long time and the procedure is likely to have been originated before the 11th century (Ajlouni and Al-Khalidi 1997; Lembbcke 1967). It is a voluntary though unbureaucratic, flexible, loyal, cooperative and helpful approach to performance improvement. It is a form of a frank exchange of information and knowledge with experts and stakeholders on an equal footing indicating systematically mutual learning. We will, however, use the term peer audit in this paper in order not to equate with peer reviews known from academic publishing.

A peer audit is, therefore, a structured process for seeking improvement by means of a professional dialogue with colleagues and—to a certain degree—also stakeholders. It can be characterized by the following features (Grol 1994; BÄK 2014):

- Peer audits are voluntary, confidential and free from recriminations and sanctions or any other penalties.
- Peer audits are undertaken by a group of 5–10 people from different HEI; the group should be interdisciplinary and represent HEI staff not only from different departments but include also employees from administration and housekeeping/facility management.
- As it is not a management review, there should be no dominance of high-level persons, such as rectors, deans or other senior or executive managers.
- Peer audits are organized regularly for a determined period, with regular meeting and activities.

[1] http://beta.merriam-webster.com/dictionary/peer and http://beta.merriam-webster.com/dictionary/group (2015-12-16).

- Peer audits are group exercises based on the principle of mutuality, i.e. visiting and visited peers are alternating.
- Peer audits apply a variety of methods and tools, based on experiences from change, quality and process management as well organizational development.
- Peer audits are considered as evidence-based, i.e. they rely on defined evaluation criteria, data collection and guidelines how to solve problems, how to reach consensus in a peer group and how to make specific arrangements.
- Consensual cooperation and support with respected peers are considered central to the process.

Peer Audits may provide a framework to gather constructive and appreciative feedback from "external insiders". The visited institution gets to know an external perspective regarding the own performance and can ascertain and assure oneself about the niveau of the own work, can demonstrate strengths and successes, gets pointed on blind spots and gets indications about improvement potentials. Peers are able to transfer pragmatic, demand-based and ready-to-use examples and best practice during an information exchange process. It is suggested that this way of a self-determined cooperation will act in a motivational way, positively influencing organizational culture (BÄK 2014).

2.3 Expected Benefits of Peer Audits

Outstanding advantages of a peer audit to improve and verify performance can be seen in (see also BÄK 2013):

- Exploitation of the "wisdom-of-the-crowd" in a self-directed learning process
- Exchange of insider tacit knowledge and experiences, benefiting from inter-disciplinary cooperation and communication
- Specific, tangible, practical feedback by colleagues rather than external experts
- Providing good practice examples from comparable, alike institutions ("if they can, why can't we?")
- Higher acceptance of future improvement measures due to diminishing hierarchical relations, not-invented-here syndrome and expert-layman-relation
- Fostering willingness and readiness to provide and to accept critical feedback
- Group consultation about improvement measures in analogy to PDCA
- Creating momentum for change and backing and mutual support in a group of responsible equals
- Support to close the gap between "CHECK" and "ACT"
- Combination of control and monitoring with knowledge transfer and identification of improvement potentials
- Initiation of a long-term oriented joint improvement process and
- Enhanced trust building, by transparent and well-documented procedures due to a developing a long-term relationship over the course of several peer-audit cycles in terms of community and network building.

3 Structure of Peer Audits

A systematic and continuous peer audit process may include all or some of the steps described in this section. Ideally, the different steps are conducted during a limited period of for instance up to three months but are part of a long-term process of continual improvement. This process is—according to the PDCA model (Deming 2000)—a process of continuously selecting problems, formulating goals, measuring the state-of-the-art, selecting necessary changes, implementing improvement projects and performing a follow-up.

The peer review proposed here compromises three distinct phases (see Fig. 1), while the focus is on phase 2, the on-site visit of the organization. Based on a self-assessment, all data necessary for the feedback of the peer group is gathered. The feedback takes place in the form of a collegial dialogue with an emphasis on constructive criticism and improvement potentials, which assumes inherent motivation and compulsory level of freedom for taking decisions. The goal of the closing meeting is to develop concrete measures and projects in order to exploit improvement potentials identified by the peer group. All the results and the recommendations will be summarized in a report. The selection, conceptualization and implementation of the measures are, however, not part of the peer review. Instead, the results should be fed into PDCA or similar management procedures.

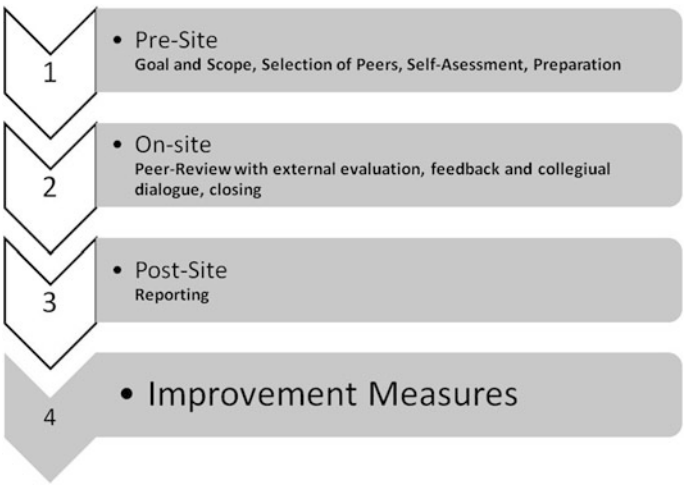


Fig. 1 Steps of a peer audit (own elaboration). *Note* Identification and commitment of improvement measures are not part of the peer audit

3.1 Pre-site Phase

When an organization, in our case an HEI, has decided to participate in the peer audit process and is willing to get audited, for example when an audit is pending according to the traditional auditing sequence, the coordinating institution, i.e. hub organisation, gets involved. A formal request will be sent from the HEI that wants to get audited and the coordinating institution will issue necessary documents and forms, such as a general description of the procedure, including a workflow, contact details and a memorandum of understanding, as well as the documents for self-assessment, declaration of agreement and the non-disclosure agreements. Upon acceptance of necessary documents by the coordination institution, the peer-review process is started and the peer review will take place within the next 6–12 months. Usually, these steps following the previous expression of interest:

(a) Goal and Scope,
(b) Selection of Peers,
(c) Self-Assessment,
(d) Preparation.

3.1.1 Definition of Goal and Scope

It is crucial to exactly define the goal and scope of the peer-audit including a description of methods and tools to be applied for data acquisition, interpretation and feedback. The goal and scope of the audit are, naturally, related to the goals of the organization. The audit scope should describe, which physical location, organisational unities or specific activities and process are covered. According to specific interests, organisational units may be selected; it should not be mandatory to include the whole organisation in the process. As the central goal of HEI is to offer to teach to students in order to prepare them for their professional career, all processes needed to deliver this output are within the scope of the audit. The core processes, i.e. teaching and research, administration and campus management are under consideration in particular regarding their sustainability performance to be evaluated with a set of key indicators and a qualitative approach with the goal to identify improvement measures.

3.1.2 Selection of Peers

Formation and composition of the peer-audit team is obviously crucial for the success of the audit. However, there is nothing like an ideal composition. The appropriateness of the audit team depends on the specific aspects of the audit. The audit team as proposed here consists of 5–7 eligible people,[2] which met fundamental qualification requirements, consists of a set of soft skills and who can demonstrate a certain level of expertise in the field.

[2]This differs from clinical audits according to BÄK (2013) where a group up to 4 persons conduct an audit.

Peer audit teams in clinical peer reviews usually exclude nurses or administrators and are thus conducted on the equal professional level of practicing physicians and medical scientists. However, for our approach, it is considered crucial to include practitioners and actual operators (administrative department, facility management, maintenance and housekeeping, purchasing agents etc.) from a pragmatic point of view without surrender potentially valuable and constructive insights and suggestions from academic staff, i.e. professors and the universities administrative heads. One experienced member of the audit team should take the role of the lead auditor, being responsible for to meet the procedural regulations and to hold and steer the consultations and conversations.

3.1.3 Self Assessment

The evaluation procedure is a two-stage process, which includes a self-assessment and the external evaluation by the peers. The organization under review is obliged to conduct a self-assessment, based on an extensive questionnaire (for example, the Sustainability Check 2.0 developed by Müller-Christ 2011 and applied at the University of Tübingen by Meisch et al. 2015). The self-assessment allows evaluating the overall sustainability performance in the organisations areas of responsibility. The self-assessment is a precondition for the peer audits, as it identifies focal points, to be treated during the peer audit. It is may be supplemented with evidence or key indicator reports or other supporting documents. Self-assessment is, therefore, a substantial instrument for all participating parties. By comparing the results, valuable information can be drawn related to the point of view of external actors.

3.1.4 Preparation of the Audit Plan

The audit plan is a description of the activities and arrangements for a peer-audit. The coordinating institution, i.e. network-hub-organisation, ensures in line with the peer audit team the following issues, documented in a declaration of consent:

- Information of the audited organisation concerning planned activities, scope and course of action, agenda, methods to be applied, inspections and interviews to be conducted, involved participants and their role in the audit team
- Notification of reference documents, including audit criteria
- Access to all data needed for the on-site visitation, including confidential agreements
- Appraisal of the self-assessment result by the peer group
- Logistic and travel arrangements.

The peer group leader, in consultation with the network-hub-organisation and the audit team, assigns responsibilities and tasks to each member of the audit team. Task assignments should respect the competence, skills and experience of the person. Responsibilities and roles of peers should be clarified. To support the

fulfilment of the task, specific work documents such as checklists and forms for the recording of information are provided.

The visited organisation guarantees that the staff and students are adequately informed about the meaning, importance and agenda. All designated persons are invited, briefed and informed about the moment when their attendance is compulsory, for example for interviews or other inquiries. An assigned person will refer as host and contact.

3.2 On-Site Phase

The central element of the peer review is the on-site visit. The procedure is as follows (see EN ISO 19011:2002, Sect. 6.4 and Brauweiler et al. 2015):

- Opening meeting with introduction of the participants and their roles, confirmation of the audit scope and objectives, agenda, methods and procedures to be conducted, short presentation of the audited university
- Checklist-based evaluation by the peers, conversation and discussion of open questions with representatives of the organisation
- Inquiry of further information during an inspection of facilities
- Peer group meeting including a discussion of preliminary audit results, discussion of exceptional cases or specific points of interest, preparation of an SWOT-analysis and substantiated, well-grounded feedback
- Closing meeting and collegial dialogue, including feedback, elaboration of recommendations for improvement, specification of tasks, arrangements and provisions, feedback to the peer group
- Reporting, presenting a summary of results and recommendations.

3.2.1 Providing Constructive Feedback

Data and information gathered is analysed and condensed by the lead auditor in order to provide a constructive and useful feedback. Identified strengths, weaknesses and improvement potentials occurring from specific observations and cases are aligned in order to present comprehensive and general conclusions. It is strictly recommended that results of the audit are based on evidence and consensus under the peers. Focus is given to systemic, general issues not to single perhaps exceptional or random, coincidental cases. Dissenting opinions, not representing the consensus of the peer group should be displayed separately. It is important not to deteriorate the quality of the peer audit with avoidable individual bias. Feedback should be provided in an appreciative, valuing way presenting improvement potential. The feedback should be structured in an alternate and bilateral way, i.e. every peer is able to say something and the audited organisation gets the chance to properly react.

3.2.2 Effective Collegial Dialogue

The dialogue is a central element in the peer audit procedure. Dialogue, as a form of collective inquiry, is key to organizational learning and linked with high expectations (Schein 1993; Senge 1990). The collegial dialogue serves not only to communicate the evaluation of the peers but in addition to conveying goals and specific measures to exploit improvement potential. As the audited organisation should have the option to react directly to the appraisals of the peers, it should also get the chance to come up with own ideas to suppress questionable activities or improvements. Ideally, the dialogue is sort of joint brainstorming which makes sense based on the contributions of all participating parties.

The dialogue is based on the willingness and readiness to cooperate in finding improvement potentials and the mutual agreement that failure is inevitable but a chance for getting better. According to Peter Senge the three basic conditions necessary for dialogue are (Senge 1990):

1. All participants must "suspend" their assumptions, literally to hold them "as if suspended before us";
2. All participants must regard one another as colleagues;
3. There must be a 'facilitator' who 'holds the context' of dialogue.

The collegial dialogue, as an outstanding form of providing feedback, should be conducted in an appreciative and constructive atmosphere. It should compromise all sustainability issues or aspects that are relevant to HEI, all dimensions of the organization, for example, administrative structures, processes and outcomes and it should rely on sound information and data. No observations that are consensual should be neglected for the sake of a misleading thoughtfulness. Identified problems should be stated clearly without any devaluation. In order not to push anyone in a defence position, root-cause-analysis should be left to the organisation itself. Instead, the talk should move rather quickly to the mutual and joint discussion of improvement potentials. As visited colleagues are included and have a voice, only relevant and promising ideas may be considered in further discussions of concrete and complement measurements. The well-known SMART-principle[3] for goal formulation applies. It can be supposed, that time is the limiting constraint in discussions like that. Therefore, a strict timekeeper is needed, holding the schedule.

3.2.3 Reporting

The results of the peer audit are presented to a wider audience, possibly under participation of the universities top management and representatives of different faculties.

[3]Goals should be specific (target a specific area for improvement), measurable by an indicator of progress, assignable (specify who will do it), realistic (state what results can realistically be achieved, given available resource), time-related (deadlines).

4 Discussion and Outlook

The paper presented an alternative approach to evaluation and auditing of sustainability programmes and management systems at HEI. A review done by peers, i.e. independent fellows from other HEI providing a constructive feedback, is considered as a valuable asset to support the continual improvement process. "External insiders" are considered as appropriate sparring partners, working in organisations of the same kind, sharing similar experiences and thus being able to pointing to focal points and willing to share innovative ideas for improvement. However, there are limits of the approach. There is a certain risk, that peers confirm themselves in a perception of organisational boundaries, hindering breakthrough innovations and improvement, thereby creating a self-reinforcing feedback loop and lock—in effects. In order to avoid any shortcomings, quite a lot of principles have to be respected (Goldman 1994 and others):

1. The audit should be oriented at actual and articulated needs of the audited organization.
2. In order to make an audit relevant, effective and reliable instrument in support of the identification of improvement potentials and for effective management decisions, adherence to a set of principles is a prerequisite. Those principles encompass for instance: (i) the use—and helpfulness for the participating parties, (ii) the feasibility and practicability backed by a proper and cost-effective procedural guidelines, (iii) accuracy, that should allow reliable and valid results of the audit. It should enable learning benefits by a distinct and explicit determination of goal and scope of the audit and the assignment of a clear and straightforward audit plan and audit agenda.
3. The peers should be fair and free of personal interest. To openly discuss individual experiences within organizations, and also reporting about failures is demanding. It requires the boldness not only to talk about good but also bad practice and the un-sustainability of organizations. Individuals will only open up and tell from their experience if there is a trustful relation between the members of the group. This requires a no-blame-approach. Outcomes of the peer-review will not be interpreted in a stigmatizing way. Feedback needs to be provided objectively and free of any accusations at personal and even institutional level.
4. The peers better occur as "critical friend" rather than a principle investigator in a control situation. Friends should truly underline their willingness to help and to accept advice. This assumes and calls for an appreciative and respectful camaraderie, which should be free of tensions that might occur between competing institutions.
5. Credibility, reliability, methodological and professional competence of the peers audit team will help to attract acceptance and give instructive feedback. A "true peer" is an external insider, who brings in theoretical knowledge about the concept of sustainability as well as methodological knowledge and pragmatic wisdom in relation to management systems. In addition, the peer is a specialist also regarding evaluation and auditing and brings in methodological skills, experience and soft skills.

For better making use of the wisdom-of-the-crowd, the University of Applied Sciences Zittau/Görlitz and its international partners seeks for opportunities for teaming up with other HEI interested in sustainability, ESD and related topics.

Acknowledgments The concept presented in this paper was developed within a project "BNC—Baukastensystem Nachhaltiger Campus" which is performed currently in collaboration between the Technical University Dresden and the University of Applied Sciences Zittau/Görlitz. The project aims at developing a comprehensive toolbox for sustainability management at German HEI. It is funded by the Saxonian Ministry of Science and Culture (SMWK). The authors thank two anonymous reviewers for their insights and comments on an earlier version of the manuscript. Any remaining errors are our own.

References

Ajlouni, K. M., & Al-Khalidi, U. (1997). Medical records, patients outcome, and peer review in eleventh-century Arab medicine. *Annals of Saudi Medicine, 17*(3), 326–327.

Anand, K. C., Bisaillon, V., & Ben Amor, M. (2016). Confronting the challenges in integrating sustainable development in a curriculum: The case of the civil engineering department at Université de Sherbrooke (Canada). In J. P. Davim & W. Leal (Eds.), *Challenges in higher education for sustainability*, *management and industrial engineering*. Switzerland: Springer International Publishing.

BÄK. (2013). Curriculum Ärztliches Peer Review. Texte und Materialien der Bundesärztekammer zur Fortbildung und Weiterbildung Band *30*, 2. Auflage.

BÄK. (2014). Leitfaden Ärztliches Peer Review. Texte und Materialien der Bundesärztekammer zur Fortbildung und Weiterbildung Band *31*, 1. Auflage.

Brauweiler, J., Will, M., & Zenker-Hoffmann, A. (2015). *Auditierung und Zertifizierung von Managementsystemen - Grundwissen für Praktiker*. Springer Fachmedien Wiesbaden.

Chambers, D. P., Walker, C. (2016). Sustainability as a catalyst for change in Universities: New roles to meet new challenges. In J. P. Davim & W. Leal (Eds.), *Challenges in higher education for sustainability, management and industrial engineering*. Switzerland: Springer International Publishing.

Dalgleish, S. (2006). Changing audits to be a value added activity. *Quality*, *45*, 18

Deming, W. E. (2000). *Out of the crisis*. Reprint: The MIT Press.

Disterheft, A., Caeiro, S., Azeiteiro, M. U., & Leal, W. (2013). Sustainability science and education for sustainable development in universities: A way for transition. In S. Caeiro et al. (Ed.), *Sustainability assessment tools in higher education institutions*. doi:10.1007/978-3-319-02375-5_1

European Commission. (2011). *Horizon 2020—The framework programme for research and innovation*. Brussels: European Commission.

Goldman, R. L. (1994). The reliability of peer assessments: A meta-analysis. *Evaluation and the Health Professions*, *17*(1), 3–21.

Gordon, D. (2001). Standards and audits will have value only if organizations being audited—And their customers—Demand it. *Quality Progress*, *34*, 80.

Grol, R. (1994). Quality improvement by peer review in primary care: A practical guide. *Quality Health Care*, *3*(3), 147–152.

ISO International Standardization Organisation. (2011). Guidelines for auditing management systems (ISO 19011).

Karapetrovic, S., & Willborn, W. (2000). Quality assurance and effectiveness of audit systems. *International Journal of Quality & Reliability Management*, *17*, 679–703. doi:10.1108/02656710010315256

Karapetrovic, S., & Willborn, W. (2002). Self audit of process performance. *The International Journal of Quality & Reliability Management*, *19*, 24–46. doi:10.1108/02656710210413435

Kluse, C. (2013). Third-party quality management system audit: Perceptions, limitations and recommended improvements. *Quality Issues and Insights in the 21st Century*, *2*(1), 4.

Leal, W. (2011). About the role of universities and their contribution to sustainable development. *Higher Education Policy*, *24*, 427–438 (Palgrave).

Lembbcke, P. A. (1967). Evolution of the medical audit. *JAMA*, *199*(8), 111–118.

Lozano, R., Lozano, F., Mulder, K., Huisingh, D., & Waas, T. (2013). Advancing higher education for sustainable development: International insights and critical reflections. *Journal of Cleaner Production, 48*(2013), 3–9.

Meisch, S., Hagemann, N., Geibel, J., Gebhard, E., & Drupp, A. (2015). Indicator-based analysis of the process towards a university in sustainable development: A case study of the University of Tübingen (Germany). In W. Leal, L. Brandli, O. Kuznetsova, & A. Finisterra do Paco (Eds.), *Integrative approaches to sustainable development at university level—Making the links*. World Sustainability Series. Springer International Publishing Switzerland.

Müller-Christ, G. (2011). Nachhaltigkeit in der Hochschule: Ein Konzept für die interne Selbstüberprüfung. In Deutsche UNESCO-Kommission e.V. (Ed.), *Hochschulen für eine Nachhaltige Entwicklung* (p. 73). Nachhaltigkeit in Forschung, Lehre und Betrieb, Deutsche UNESCO Kommission.

Raskin, P. D. (2012). Higher education in an unsettled century: Handmaiden or pathmaker? In GUNI (Ed) *Higher education in the world 4. Higher education's commitment to sustainability: From understanding to action. GUNI series on the social commitment of universities 4* (Vol. 1, pp 18–28). Basingstoke: Palgrave Macmillan.

Sayle, A. (1999). *Value added auditing—Our future.* Keynote Address at the 8th Annual ASQ Quality Audit Conference, Houston, TX. Retrieved from http://www.sayle.com/sayle/Articles.htm June 22, 2015.

Sayle, A. J. (1995). Auditing: Time for a rethink and overhaul. *Quality World*, *29*, 249–257.

Schein, E. (1993). *On dialogue, culture, and organizational learning*. doi:10.1016/0090-2616(93)90052-3

Schneidewind, U. (2014). Von der nachhaltigen zur transformativen Hochschule. Perspektiven einer "True University Sustainability". *uwf, 22*, 221–225. doi:10.1007/s00550-014-0314-7

Schneidewind, U., & Singer-Brodowski, M. (2014). Transformative Wissenschaft. Klimawandel im deutschen Wissenschafts- und Hochschulsystem, 2. Aufl. Metropolis, Marburg.

Senge, P. (1990). *The fifth discipline: The art and practice of the learning organization*. London: Currency, Random House.

Tilbury, D. (2012). Higher education for sustainability. A global review of commitment and progress. In GUNI (Ed.), *Higher education in the world 4. Higher education's commitment to sustainability: From understanding to action. GUNI series on the social commitment of universities 4* (Vol. 1, pp. 18–22). Basingstoke: Palgrave Macmillan.

University Hamburg—Kompetenzzentrum Nachhaltige Universität (KNU). (2013). Ideen zur Ausgestaltung der Universität Hamburg als Universität für eine nachhaltige Zukunft. Positionspapier des Kompetenzzentrums Nachhaltige Universität, Hamburg

Wals, A. J. (2012). Shaping the education of tomorrow: 2012 full-length report on the UN decade of education for sustainable development. Commissioned by UNESCO

Will, M., & Rydén, L. (2015). Trans-disciplinarity in sustainability science and education. In W. Leal, L. Brandli, O. Kuznetsova, & A. Finisterra do Paco (Eds.), *Integrative approaches to sustainable development at university level—Making the links*. World Sustainability Series. Springer International Publishing Switzerland.

Wissenschaftlicher Beirat Globale Umweltveränderungen (WBGU). (2011). *Welt im Wandel. Gesellschaftsvertrag für eine Große Transformation. Hauptgutachten*. Berlin: WBGU.

Author Biographies

Markus Will Dipl-.Ing (FH), works as a lecturer at the University of Applied Sciences Zittau/Goerlitz and as a consultant and trainer. His academic interests lie in life cycle assessment, technology assessment and innovation theory.

Anke Zenker-Hoffmann Diplom Kauffrau, works as research associate and lecturer at the University of Applied Sciences Zittau/Goerlitz, Germany. There she is a member of the task group on EMS since the beginning in 1999. She is an expert in environmentally oriented business management with consulting, auditing and training and teaching experience in the field of management systems.

Dr. Jana Brauweiler is a professor of "Integrated Management Systems" at the University of Applied Science Zittau/Goerlitz. Her teaching and researches focus on management systems and project management. She has conducted research and practical projects with national and foreign university and industry partners. She is qualified as an Internal Environmental Auditor (TÜV academy) and certified Project Management Professional (GPM), IPMA Level D®.

Bernd Delakowitz is full professor for environmental management, environmental law and life cycle assessment (LCA) since 1996. He is an environmental expert with approximately 30 years of professional expertise in the fields of nuclear waste disposal, lecturing on higher education level, research & development, and training on management systems (EMS, QMS, OH & S) as well as in higher education administration.

Integration of Research, Teaching, and Practice in the Implementation of the Michigan State University Energy Transition Plan

Wolfgang Bauer, Dan Bollman, Robert Ellerhorst, William J. Latta and Nate Verhanovitz

Abstract

In 2012 Michigan State University (MSU) created a plan (MSU Energy Transition Plan, 2012), which attempts to move the university toward 100 % renewable energy sources and reduced greenhouse gas emissions. This plan has to overcome special challenges due to the fact that MSU's 50,000 student campus self-generates almost 100 % of its electricity and building heat, and that approximately three quarters of its annual energy consumption need to flow into heating the buildings. This paper lays out the roadmap for the Energy Transition Plan and describes the first steps taken towards its goals with the implementation of aggressive energy conservation and recycling programs, changing the fuel source for the university's power plant from coal to natural gas, the construction of a biogas-producing anaerobic digester for cafeteria waste and animal excrements, and the installation of a large (11 MW) solar array. Special attention is given to the integration of the research and teaching missions of the university with the day-to-day operation of the physical plant to ensure reliability of the power supply as well as optimization of the cost structure of the university's energy portfolio.

W. Bauer (✉) · D. Bollman · R. Ellerhorst · W.J. Latta · N. Verhanovitz
Michigan State University, Hannah Administration Building,
426 Auditorium Road, East Lansing, MI 48824, USA
e-mail: bauer@pa.msu.edu

D. Bollman
e-mail: Dbollman@ipf.msu.edu

R. Ellerhorst
e-mail: Rlellerh@ipf.msu.edu

W.J. Latta
e-mail: latta@adminsv.msu.edu

N. Verhanovitz
e-mail: nverhanovitz@ipf.msu.edu

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_28

Keywords
Renewable energy · Greenhouse gas emissions · Energy efficiency · Solar power · Biofuels · Geothermal power · Data center · Sustainability

1 Introduction

Michigan State University (MSU) is operating its own combined heat and power plant and produces essentially all of its electricity and building heating and cooling. With its ability to function in 'island-mode' MSU can serve as a model for the integration of renewable energy resources into the power production portfolio on the scale of a mid-sized city. We start by giving a historical perspective on how fuel choices and the shifting balance between steam and electricity demands have shaped the current constraints on the existing MSU infrastructure and installed generating equipment. Then we discuss the considerations that led to the 2012 Energy Transition Plan. And finally we detail the implementation of the steps of the Energy Transition Plan and the individual renewable resources that were integrated into our power and heat generating structure, focusing on the opportunities for scholarship and teaching and learning provided.

2 History of Combined Heat and Power at MSU

Michigan State University was founded in 1855 under the name Agricultural College of the State of Michigan, which was changed to Michigan Agricultural College in 1909, to Michigan State College of Agriculture and Applied Science in 1925, and to Michigan State University of Agriculture and Applied Science in 1955. Since 1964 the institution has used its current name, Michigan State University (MSU).

Initially all of the college's buildings were heated with wood fireplaces. A series of building fires resulted from utilizing this technology, and in 1882 the college built a central boiler house to provide heat for its buildings. This heat was delivered in form of steam via a district heating system consisting of underground steam pipes (Forsyth 2016). In 1894 a power plant was completed, which allowed for partial electrification of the campus (Beal 1915). Coal became the major fuel for the campus in 1901, when the Pere Marquette railroad spur was constructed.

A second boiler house was constructed in 1904, along with a network of underground tunnels of six foot six height, which housed the steam pipes and conduits for electricity and telephone wires. This tunnel system initially had a total length of approximately 4100 ft. In 1921 the third campus power plant was constructed, and the old boiler houses were torn down (Koenigsknecht 2011).

After the Second World War a large influx of students and rapid expansion of campus, primarily as a result of the 1945 G.I. Bill helping WWII veterans to receive an education, necessitated the construction of a new power plant in 1948. This fourth plant, located next to the Spartan football stadium, was the main campus source of electrical power until 1965 and used seasonally until 1975.

The fifth and current MSU power plant, the T.B. Simon Power Plant, was put into operation in 1966. At this time the third campus power plant was demolished to make room for the current administration building (Stanford and Dewhurst 2002). The T.B. Simon Power Plant initially had two coal-fired boilers and steam turbine generators, each with a generating capacity of 12.5 MW. In 1974 a third boiler and 15 MW steam turbine generator was added to the T.B. Simon Power Plant, allowing the shutdown of the fourth power plant. In 1974 a fourth boiler unit with fluidized bed and capability of burning multiple fuels was added. Its 21 MW steam generator turbine brought the total electrical peak capacity to 61 MW and made the T.B. Simon Power Plant the largest coal-fired campus power plant in the country. Finally, in 2006 a 24 MW steam turbine driven by a heat-recovery steam generator and a gas combustion turbine with 14.3 MW peak capacity were added, affording the T.B. Simon Power Plant a total peak electrical generating capacity of 99.3 MW. Through careful maintenance all of these 6 power-generating units are still in use today, even after 5 decades of operation of the first units.

The five boilers co-generate electricity and superheated steam by producing steam at a pressure of 875 psi, which is initially used to drive steam turbine generators and then sent through the steam tunnels at a pressure of 90 psi to heat the large majority of campus buildings, now in excess of 17 million square-feet. The steam tunnel network has now grown to a length of more than 13 miles and recently underwent extensive renovations. This electricity and steam co-generation allows the T.B. Simon Power Plant to operate at an average total efficiency of approximately 61 %.

3 Campus Power and Heat Consumption

MSU's rapidly growing student numbers and research productivity has resulted in strongly increasing demands on steam production, but even more so on electricity generation. We examined the annual campus electricity generation over the five decades of the lifetime of the T.B. Simon Power Plant. In fiscal year 1965–66 the electricity production was approximately 120 GWh, and by fiscal year 2012–13 it had increased to approximately 347 GWh, almost tripling over this period of time (solid line in Fig. 1). Since 2012–13 the electricity production has been reduced slightly, in part due to an aggressive energy conservation and efficiency improvement program, as well as due to an increase in off-campus purchases of electricity to take advantage of favorable off-peak rates. During each year between 74 and 81 % of the generated electricity were consumed on campus, with remainder being used to operate the plant and generation equipment.

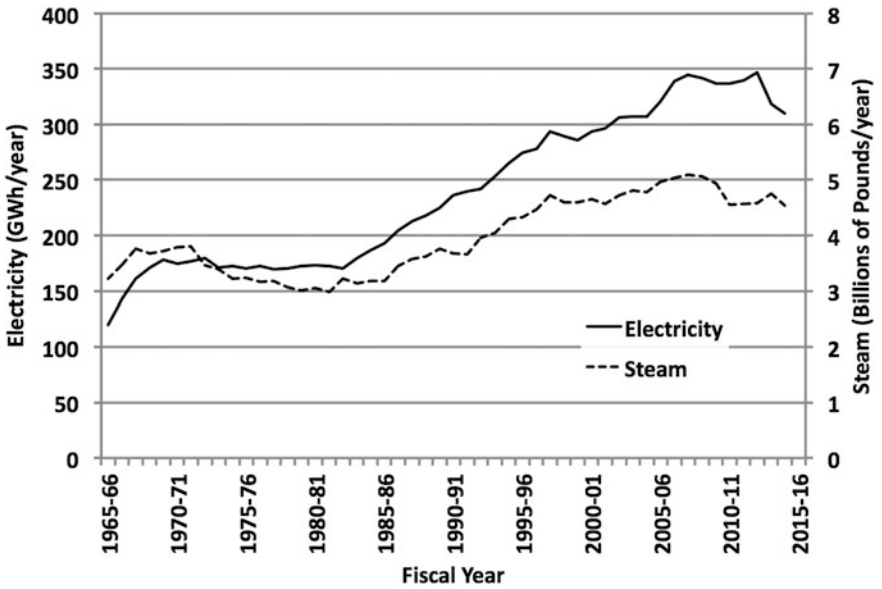


Fig. 1 Time evolution of electricity and steam production at MSU

We can also obtain the total annual steam generation as a function of time (dashed line in Fig. 1). Between 46 and 61 % of this steam has been sent out to campus to heat the buildings, and the remainder was used for electricity production, or, if the electricity demand outpaced the needs for steam, it was simply condensed in cooling towers. Steam demand only increased by less than 50 % during the five decades shown, and the growing imbalance between electricity and steam demands on campus has resulted in a gradual erosion of the overall efficiency of the co-generation process at MSU's T.B. Simon Power Plant.

4 Campus Fuel Mixture

As mentioned above, the main campus fuel at MSU had been coal at least since 1901, when the second MSU power plant was connected to the railroad network. All the way until 2006 coal remained almost the sole fuel powering MSU, even though the first 4 boiler units in the T.B. Simon Power Plant had the capability to burn gas as well. After the installation of the gas combustion turbine in 2006 natural gas became an appreciable part of the fuel mix at MSU.

It is instructive to examine the year-by-year fuel mix during the last decade at MSU (Fig. 2). During this time MSU consumed an average of 6.35 trillion BTU (British Thermal Units) of input energy, with a range between 6.10 and 6.53 TBTU, primarily depending on the severity of the winter weather. One can see that starting

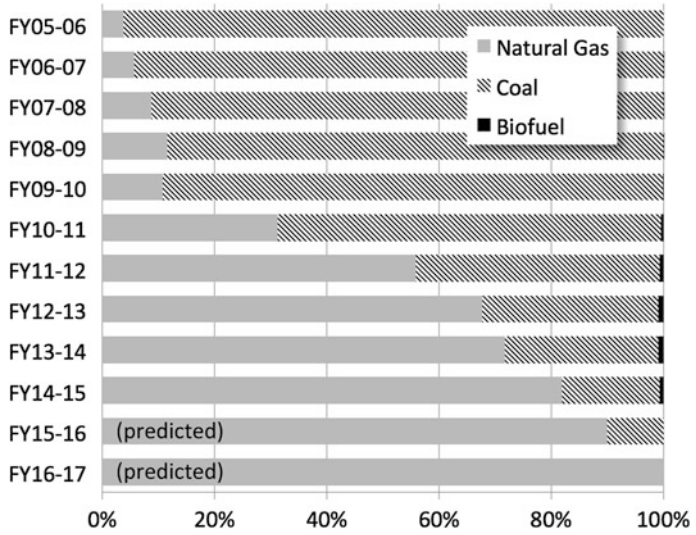


Fig. 2 Year-by-year fuel mixture utilized in the T.B. Simon Power Plant

in FY2011–12 natural gas became the dominant fuel. In April 2015 MSU announced that it would stop burning coal by spring of 2016, after consuming the remainder of the coal pile stored locally. Burning bituminous coal produces approximately 206 lb of carbon dioxide per million BTU, whereas natural gas combustion only emits 117 lb of CO_2 per million BTU (DOE-EIA 2015). Therefore the switch from coal to gas resulted in approximately a 43 % reduction in CO_2 emissions over the 10-year span during which the conversation took place, which is approximately 575 million pounds (= 256,000 metric tons) for MSU. In addition, burning natural gas also reduces greatly the emission of other pollutants, such as dust particulates of diameter less than 2.5 μm (PM2.5), which have been shown to cause 200,000 early deaths per year in the USA (Caiazzo et al. 2013).

In the last decade we also had a small contribution of biofuel to the fuel mix for the T.B. Simon Power Plant. This biofuel fraction reached a maximum of 0.9 % in the fiscal years 2012–13 and 2013–14, but with the complete conversion of the boilers to natural gas the use of biofuels had to be curtailed. Even though this constitutes a slight reduction in renewable energy use at MSU, it is more than compensated for by the overall reduction in harmful emissions.

5 The MSU Energy Transition Plan

In 2009 the university set out to create a long-range plan in order to transition out of a fossil-fuel dominated power and heat production with its rather large greenhouse gas emission footprint contributing to global warming (NRC 2010) into one that

relies on renewable energy resources, with the ultimate goal transitioning into 100 % renewable energy use. In 2011 a 25-member steering committee consisting of 6 students, 9 faculty members, and 10 staff members and administrators was formed. This committee reached out to the students involved in the MSU Beyond Coal and Greenpeace movements, as well as to the overall student population and the broader MSU and East Lansing area communities. It authored a report (MSU Energy Transition Plan 2012), which proposed very aggressive targets for reduction of emissions and adoption of renewable energies. The three main goals of the plan are: (1) Improve the physical environment, (2) Invest in sustainable energy research and development, and (3) Become an educational leader in sustainable energy. At the same time the energy transition plan steering committee made sure to keep an eye on costs, environmental impacts, and future growth needs of the university. The MSU Board of Trustees approved this plan in April 2012.

The MSU Energy Transition Plan set future goals for the fraction of campus renewable energy use and for the total greenhouse gas emission reduction (Table 1). The first evaluation point of the plan, FY2015, has been concluded. Since the baseline chosen for the energy transition plan was FY2010, in which some fraction of the emissions reductions due to the fuel switching were already achieved, it has been harder to meet the goals. Relative to FY2010, a reduction of 30.8 % in CO_2 emissions was achieved. (This number has been adjusted to a weather corrected baseline of 6.35 TBTU annual fuel consumption.) The share of renewable energy campus use in FY2015 was at 8.5 %, significantly below the 15 % target. This was in part due to the curtailment of biofuel burning at the T.B. Simon Power Plant.

In the spring of 2017, with the completion of a new substation connecting MSU to the outside grid and allowing the transmission of a much larger power load than previously, it will be possible to purchase electricity and address the balance between steam load and electrical load on the T.B. Simon Power Plant. Further gains in overall efficiency and thus emissions reductions can then be expected, while at the same time saving even more funds from the operations budget, which can be redirected to academic programs. Present simulations of the anticipated optimal purchase patterns indicate annual savings of up to approximately $2.4 million and a net reduction of 20,000 tons of CO_2 emissions, if MSU utilizes the fuel mix of the available grid power. If MSU accepts the "green" surcharge of presently $7/MWh and uses green grid power, then the emission saving will increase to 76,000 tons of CO_2 per year.

Table 1 Goal timetable of the MSU Energy Transition Plan

	% campus renewable energy	% greenhouse gas emission reduction
FY2015	15	30
FY2020	20	45
FY2025	25	55
FY2030	40	65

6 On-Campus Renewable Energy Use and Teaching and Learning Opportunities

Combining practical implementation of renewable energy resources with research and teaching is at the core of the MSU Energy Transition Plan, as is the improvement of energy efficiency and reduction of energy use on campus. The following gives a partial overview of ongoing efforts.

6.1 Biogas

In 2013 MSU designed and constructed a biogas project in collaboration with Anaergia. This anaerobic digester is an improvement over a previous design (Bauer 2013, 2015) and uses farm manure, food processing waste, cafeteria food scraps, and fats, oil, and grease, as well as milk processing waste, as input substances for an anaerobic digester. In 2015 the total feedstock was 22,070 tons. The biogas (60/40 mixture of methane and carbon dioxide, with traces of other gases) is used as combustion fuel for a gas engine and produces a sustained 400 kW of electricity and another 450 kW of heat (MSU-Digester 2014). The digester is used for basic and applied research, as well as for teaching purposes. Ten different MSU classes have used the digester facility as part of their teaching portfolio during the past academic year. Typically these classes use the digester facility anywhere from one-time field trip on-site visits all the way to semester-long real-life laboratory courses. One MSU class, BE475 in the bio-systems engineering program, even combines this teaching tool with a study abroad summer program in Germany and Sweden.

6.2 Spartan Treasure Hunt/Better Buildings Challenge

The greenest energy is the energy not used. In collaboration with General Electric MSU started a program of examining energy use and eliminating energy waste on a building-by-building basis in 2013. The first two building complexes in this program were the Biomedical and Physical Sciences Building and the Engineering building complex. A team of approximately 40 students, faculty, and staff, in approximately equal parts comprised of building occupants and members of the central facilities team met for two days, researched energy use, discussed ways to improve, and wrote up a final list of recommendations. Through application of the Spartan Treasure Hunt facility occupant engagement method, we have evaluated 25 buildings totaling 4,576,992 ft^2 and have identified a total of 669 energy conservation measures (ECMs). To date, two facilities have received funding for ECM implementation at a total cost of $2,166,000 resulting in an annual cost avoidance of $790,000 and over 10 % energy reduction in each facility.

The Better Buildings project of the U.S. Department of Energy is an initiative to optimize energy use and energy savings through building redesign. MSU participates in this project and has completed the upgrade process for the 317,200 square-foot Anthony Hall (34 % energy savings), as well as the 252,000 square-foot Erickson Hall (31 % energy savings).

6.3 Geothermal Energy

Geothermal systems with heat pumps can provide valuable contributions to building heating. In 2012 MSU constructed the 48,000 square-foot Bott Building for Nursing Education and Research and decided to utilize a horizontal geothermal field for building heating. This array of the size of a football field was later augmented with vertical wells and contributed to the Bott Building winning the 2013 Green Judges' Choice Green Education Design Showcase award. The first complete year evaluation of the building energy consumption indicates a contribution of approximately 467 million BTU of geothermal energy to the overall building energy consumption, an approximate share of 20 %. Future senior engineering classes and thesis projects will have the ability to study the performance of this geothermal field and to create improved designs for future projects.

6.4 Data Center Design

Data centers are an ever-increasing consumer of electricity on college campuses. MSU is in the process of designing a new campus datacenter for administrative and academic research computing. This data center will provide flexible and expandable white space at the lowest possible energy consumption for data center cooling. Water-cooling of the servers via rack-rear-door heat exchangers (Bach et al. 2013) is one of the options explored, and a mechanical engineering capstone class, ME416, used the design of a heat exchanger between the closed loop cooling of the data center and the MSU drinking water underground pipelines as its final project. A PUE (= power usage effectiveness = ratio of total power consumed by the data center/power consumed by the servers) of less than 1.1 is the target, whereas current PUE values for existing data centers on campus range from 1.6 to significantly larger than 2. Engineering senior capstone classes have worked on heat exchanger designs for this facility, and future engineering capstone classes will have the opportunity to improve the data center efficiency by refining the pipe design, pump performance, and sensor integration during real-time operation of the data center.

6.5 Solar Array

Starting in 2015 MSU partnered with Customer First Renewables and Innovateus to design, construct, and operate an 11 MW solar array in the form of carports over 5

different large commuter parking lots. This array is currently under construction and when finished will provide approximately 5 % of the annual electricity consumption of the entire MSU campus. Remarkably, due to the availability of the solar power during the highest demand times, this peak shaving will result in this green power becoming cheaper than brown power within 5 years, based on a 2.3 % utility price growth rate predicted by the US DOE-EIA (2015). Over the 25-year life of the solar arrays MSU is expected to reap savings of approximately $10 million in electricity costs.

MSU is a leader in the research on advanced photovoltaic films (Lunt 2012; Suddard-Bangsund et al. 2016), on complex materials with energy applications, and on micro-grid inverters (Qian et al. 2011; Lei et al. 2011). Collaboration with our commercial partners will open new applied research opportunities and serve as real-life teaching laboratories. One senior undergraduate engineering capstone class, ECE480, even designed a computer-controlled early warning system, which can predict large fluctuations in the output of the solar arrays and will enable MSU to compensate through dynamic micro-grid load shifting. A student competition on innovative and creative new solar panel designs was held in the fall semester, and prizes were awarded in December 2015 (Energy Innovation Award 2015).

7 Looking Forward

MSU is a large research university with a 5200-acre campus and one of the largest residence hall systems in the world. Since MSU is producing its own electricity and district heat, the university can serve as a model laboratory for cities of the future. Its own micro-grid can exist in island mode and allows us to study the integration of renewable energy and smart grid technologies. The Energy Transition Plan has set very ambitious and aggressive goals for the near and distant future. Existing renewable energies can be amplified and others (wind, deep geothermal, bio-energy crops, and more) will be explored. The future for renewable energy research, teaching and learning at MSU is shaping up to be exciting.

References

Bach, M., de Cuveland, J., Ebermann, H., Eschweiler, D., Gerhard, J., Kalcher, S., et al. (2013). *A comprehensive approach for a power efficient general purpose supercomputer*. In Proceedings of 21st euromicro international conference on parallel, distributed and network-based processing (PDP), IEEE, pp. 336–342.

Bauer, W. (2013). Net energy ratio and greenhouse gas analysis of a biogas power plant. *Journal of Energy and Power Engineering, 7*, 1656–1661.

Bauer, W. (2015). Biogas beats bioethanol. *Asia Pacific Biotech News, 19*(8) (Biofuels), 16–17.

Beal, W. J. (1915). *History of the Michigan Agricultural College; and biographical sketches of trustees and professors*. State Printers, Lansing, Michigan: Wynkoop Hallenbeck Crawford Co.

Caiazzo, F., Ashok, A., Waitz, I. A., Yim, S. H. L., & Barrett, S. R. H. (2013). Air pollution and early deaths in the United States. Part I: Quantifying the impact of major sectors in 2005. *Atmospheric Environment, 79*, 198–208.

DOE-EIA. (2015). *How much carbon dioxide is produced when different fuels are burned?* https://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11 (Last Accessed January 20, 2016).

Energy Innovation Award. (2015). http://bespartangreen.msu.edu/news.php?id=2015-12-14-msu-recognizes-students-for-solar-innovation (Last Accessed January 20, 2016).

Forsyth, K. (2016). *A brief history of east lansing, Michigan. City neighborhoods and the Campus Parks, 1850–1925*. http://kevinforsyth.net/ELMI/power.htm (Last Accessed January 20, 2016).

Koenigsknecht, T. (2011). *Exhibit—Exploring the evolution of energy: A history of Michigan State University Energy Use*. http://onthebanks.msu.edu/Exhibit/1-6-A/history-of-campus-energy-use/ (Last Accessed January 20, 2016).

Lei, Q., Peng, F. Z., & Yang, S. (2011). Multi-loop control method for high-performance micro-grid inverter through load voltage and current decoupling with only output voltage feedback. *IEEE Transactions on Power Electronics, 26*(3), 953–960.

Lunt, R. R. (2012). Theoretical limits for visibly transparent photovoltaics. *Applied Physics Letters, 101*, 043902.

MSU-Digester. (2014). Michigan State University South Campus Anaerobic Digester. https://www.americanbiogascouncil.org/projectProfiles/eastLansingMI.pdf (Last Accessed January 20, 2016).

MSU Energy Transition Plan. (2012). http://energytransition.msu.edu/uploads/energy_transition_plan_final.pdf

NRC. (2010). *Advancing the science of climate change. National research council*. Washington, DC, USA: The National Academies Press.

Qian, W., Peng, F. Z., & Cha, H. (2011). Trans-Z-source inverters. *IEEE Transactions on Power Electronics, 26*(12), 3453–3463.

Stanford, L. O., & Dewhurst, C. K. (2002). *M.S.U. Campus—Buildings, places, spaces: Architecture and the Campus Park of Michigan State University*. East Lansing, Michigan: MSU Press.

Suddard-Bangsund, J., Traverse, C. J., Young, M., Patrick, T. J., Zhao, Y., & Lunt, R. R. (2016). Organic salts as a route to energy level control in low bandgap, high open-circuit voltage organic and transparent solar cells that approach the excitonic voltage limit. *Advanced Energy Materials*, *6*, 1501659.

Authors Biography

Professor Wolfgang Bauer received his Ph.D. in physics from the University of Giessen, Germany, in 1987. He has been a member of the faculty of Michigan State University since 1988, holding the title of University Distinguished Professor since 2007. He was chair of the Department of Physics and Astronomy from 2001 to 2013 and Founding Director of the Institute for Cyber-Enabled Research from 2009 to 2013. In the last decade his research has concentrated on renewable energy technology, in particular biofuels. He co-owns several companies in this field and has performed consulting work in the renewable energy sector for oil companies and hedge funds. Since 2013 he serves as senior consultant in the office of the Executive Vice President for Administrative Services at Michigan State University.

Dan Bollman holds a Bachelor of Science in Civil Engineering (1984) and Masters in Resource Development (1995), both from Michigan State University. In his current role as Associate Vice President for Strategic Infrastructure Planning & Facilities, Michigan State University (MSU), USA, Dan has leadership and management responsibility for a staff of approximately 1350 employees and is responsible for delivering $174 million in facility services to the campus

community annually. Additionally, he is responsible for in excess of $1 B in capital construction put in place over the past decade. Dan has worked for Michigan State University for 25 years in a variety of facility related capacities. Prior to that he spent 5 years in the U.S. Navy as a lieutenant in the Civil Engineer Corp.

Robert Ellerhorst is the Director of Utilities at the Power and Water Department of Michigan State University (since 1990). Ellerhorst's responsibilities include managing the Power and Water Department to provide reliable and affordable energy and water to MSU faculty, staff, students, and the visiting public. Ellerhorst has a Bachelor of Science (1974) and a Master of Science (1976) in civil/structural engineering; all from MSU. Ellerhorst is a licensed Professional Engineer in the State of Michigan (1979).

Dr. William (Bill) Latta has over 35 years of extensive and broad university administrative experience in a large public university setting. Currently he is the Assistant Vice President for Operations and works in the Office of the Executive Vice President for Administrative Services at Michigan State University. Among the projects he is involved with, facilitating achievement of the university's energy transition plan goals and planning for the future utility power needs of the campus are highly significant. He also provides leadership for a variety of interdisciplinary issues involving the integration of forward planning, physical and business infrastructure, academic and support programs, and their impact on the quality and health of the campus.

Nate Verhanovitz has served Michigan State University since 2005 in various engineering roles. He is presently the performance engineer for the Power and Water department of the Infrastructure Planning and Facilities division of MSU. His primary responsibilities are optimizing thermodynamic processes within the central power plant while maintaining high reliability and quality of electrical and steam utility service.

The Combined Effects of Education and Research on Sustainable Development in the Immanuel Kant Baltic Federal University (Russia, Kaliningrad)

Eugeny Krasnov and Elena Kropinova

Abstract

This paper presents the results of the research around the three main topics the activity of the Baltic University Programme; the Sustainable Tourism; the Economy of Knowledge for the New strategy vision of the Kaliningrad region development. The Baltic University Programme (BUP) in Kaliningrad serves mostly for the natural and humanitarian knowledge development, the project oriented teaching, for the rational usage of the natural resources and development of human capital in the region. The sustainable tourism is undertaken as a subject of education and tourism (studying both the barriers and the perspectives). The economy of knowledge for the regional development resulted in the new interdisciplinary courses and projects. Finally there is a proposal for the development of the special algorithms of Actions for the Civil Society in accordance with the Helsinki Commission Recommendations for the Baltic Sea Coastal Zone development, including Russia. The paper will be useful to anyone interested in the role of the Russian universities in the raising the awareness in sustainable development and in the concrete actions undertaken by them in 1990s—till 2015 (case for the Kaliningrad region of Russian Federation).

Keywords

Baltic universities programme · Economy of knowledge · Sustainable tourism

E. Krasnov (✉)
Institute of Natural Use, Territorial Planning, and Urban Development,
Immanuel Kant Baltic Federal University, 236041 Kaliningrad, Russia
e-mail: ecogeography@rambler.ru

E. Kropinova
Institute of Recreation, Tourism, and Physical Education,
Immanuel Kant Baltic Federal University, 236041 Kaliningrad, Russia
e-mail: kropinova@mail.ru

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_29

1 Introduction

The Kaliningrad region (former Eastern Prussia) existed up to the end of the Second World War. By the decision of the Potsdam Conference in 1945 two thirds of its area were given to Poland, and one third (adjacent to Koenigsberg)—to Russia, where in 1946 the Kaliningrad oblast within the Russian Federation was found. Till 1991 the region had limited entrance regime and absence of international contracts due to its strategic role at the border of the Soviet Union.

Today there are nearly one million people in the region. The largest city is Kaliningrad with 443.8 thousand people. There are more than 30 nationalities in the oblast. 82 % quarters of the population are Russians, 3.5 % are Belarusians, 3.5 % are Ukrainians, 1 % are Lithuanians, 10 % are other nationalities.

Since the 1990s, there were drastic changes in the structure of the regional economy. On the one hand, it led to a decline in industrial production, but on the other hand, for example, closing the pulp and paper mill because it is unprofitability—to the improvement of the water and air quality. Nowadays the Kaliningrad region plays an important role in the economic and social life of Russia. There are non-freezing port on the Baltic, various mineral resources usage (oil, peat, amber, salts etc.), area of recreation on the sea cost (sand dunes, beaches), and a scientific and cultural center for investigation of the World Ocean.

You can track here as well the combined effect of the activity, conducted by the Baltic University Programme—BUP (the network of the Universities around the Baltic Sea, coordinated by the Secretariat in the Uppsala University). So, the beginning of 1990s was held under the auspices of topic "Ecology of the Baltic Sea"—our common Baltic and we must make efforts to its revitalization. The result was the creation of TV—courses and 10 books in Russian and English. More than 500 Kaliningrad students have attended the BUP course "The Baltic Sea Environment". At this time the Pulpit "Geoecology" was opened in the Immanuel Kant Baltic Federal University (IKBFU). The ecology—has become a compulsory subject in all educational programs. Since the mid-90s, the role of the social sciences rose. It is clear that the formation of moral and ethical principles is a fundamental principle of environmental education. The BUP course of lectures "The peoples of the Baltic" is introduced as a compulsory subject of a regional component. At this time, there is a need for continuing education on the issues. This improvement in the ecological education of municipal employees is the key to success in the implementation of sustainable development technologies at the level of urban management. As part of the BUP the course of lectures "Sustainable Community Development" has been designed. However, the sustainable development is possible only through an integrated approach. As a part of the BUP a unique monograph has been created, and a new Master Course "Environmental science" was opened, which became to be a bestseller for students of the Baltic region. Creation of the Kaliningrad regional BUP Centre in 1998 allowed our University to meet the trend of events and to facilitate the process of greening of education at all levels of training (school-bachelor-master-PhD student, continuing education).

Along with the modernization of the educational process the modernization of the University itself takes place from the standpoint of sustainable development. With the assistance of BUP the Energy Efficiency Center was established, which implements currently monitoring of the energy efficiency inside the buildings of the I.Kant Baltic Federal University, as well as by providing services on the energy efficiency of buildings for municipalities in the region to improve the skills of employees of municipalities in the framework of the "Energy Efficiency". At the level of the faculties/institutes the greening process in the education can be presented as a case for the Institute for recreation, tourism and physical education. For example, the project named «Bridges» resulted in the development the Dual diploma Master-level course «Tourism marketing for SD», as well as developed and implemented in most of specializations "Ecotourism" was implemented here. To evaluate the combined effect of the common education and research was required to determine the general methodological bases.

2 Methodological Approach

The BUP is a unique educational project, aiming at sustainable development of the Baltic Sea Region. International interuniversity cooperation facilitates intercultural communication between students and researchers, and creates new opportunities for joint research; the project also focuses on solving ecological and social problems in the Baltic Sea region. This is a network of 232 national universities and institutions operated by producing courses on sustainable development studies of the region, its environmental and political changes. In 2015 the BUP network delivered courses in more than 180 universities serving nearly 9500 undergraduate and graduate students.

For example, the Envirovet Baltic, a network of environmental health scientists/educators from USA and the nine countries bordering the Baltic Sea, was founded in 2001 on an initiative of the College of Veterinary Medicine, University of Illinois and the Center for Reproductive Biology in Uppsala, SLU with scientist from university in the Baltic Sea Region (BSR). Courses are delivered separately by each university in the network in both cases.

The BUP, first of all, is a multinational community of researchers for comprehensive study of regional environmental, social, and economic problems all together by students, teachers and stakeholders outside of the university in accordance with global changes dynamic in nature and nations. Deep roots of global and regional unsustainability in the world conduct us to use for research and education interdisciplinary approaches which are cover the effects of environmental impacts on landscape, biodiversity, water quality, atmosphere, soil, ecosystems, and people. We also examined the topic on how society deals with environmental impact by economic, legal, and engineering means as well as the international cooperation. Important attention is given to eco-audit and eco-management issues as a systematic

way for society to understand and solve environmental, social, and economic problems (as combined effects).

In the BUP activity it significantly related with case studies mostly from the regions, and comparisons of situation in the North Europe and the North America. There are also analyses on legal basis from UN conventions as well as from European Union and Russian Federation normative acts that deal with the environment. So, the BUP is defined as the interface between society and nature. The content of monographs and text-books here is highly interdisciplinary with equal attention to natural and social sciences. Ethics, behavior, lifestyle chapters are also included.

The regional Center of BUP in Kaliningrad was founded in 1997 and today it coordinates activity of 250–300 students and teachers from four universities and institutions. Together with teachers our students participate in the different courses, conferences, workshops and projects both on optional and compulsory base. At this moment Kaliningrad students have received more than 150 diplomas and certificates of participation in different events organized by the BUP. The main purpose of our work is to promote and implement the Sustainable Development Concept in the new fishery technology, agriculture, tourism and recreation as well as for the nature protection and revitalization.

3 Principles of Bioeconomy Studies as Key Problem in the Rational Management and Exploitation of Marine Bioresources

At present, this problem occupies a certain position in Russian research. For instance, the first version of an electronic register system has been set up and is working successfully. It covers above 600 principal inland basins of Russia. The elaboration of the registers for maritime national borders and the Atlantic Ocean has begun. However, chronic lack of funds is delaying the practical research need before a regional register system can be drawn up for the ocean. There is an urgent need to set up special bioeconomic units at the Baltic University, to place the necessary structures on an improved financial footing, and to give the corresponding researches an applied character (Fedorov and Krasnov 2012).

Formerly, studies of this kind were carried out on a minor scale at Kaliningrad. However, these activities have ceased with few exceptions owing to the lack of funding and of special bioeconomic sections. Under present day conditions, the need to make decisions on this problem has become urgent.

Ecological-economic expertises are urgently needed as an instrument for the protection and rational exploitation of marine bioresources. However, it must be noted that the methodic needed for such expertises are weak and need radical improvement. The elaboration and approval of ecologic-economic standards for important industrial models on the Baltic shores is of great importance for the solution of this problem.

The topicality and essence of this problem consists in the inclusion, during the elaboration of resource databases at fishery institutes, those economic characteristics into forecasts which could help to solve management problems more effectively and so help to reduce the economic risk for fishing farms. These investigations are not being carried out owing to the lack of financial support. The need for investigations of this kind is increasing considerably during the present transition of the fishing industry pass to a free economy (Ionov and Kropinova 2010).

This is one of the few bioeconomic fields in which studies have been regularly performed. The results have been taken into account in the educational process. However, the studies need further enlargement and quantitative improvement.

Some current local bioeconomic problems such as the improvement of economic geographical regionalization of the oceans on the basis of commercial fisheries, the composition textbooks and teaching aids dealing the economics of using natural resources in the fishing industry, etc., are also reflected in the curriculum of the Kaliningrad Technical Fisheries University.

Considering the numerous research trends, it should be noted that success depends on where the activities are organized. Experience shows that such investigations are performed most efficiently by commercial fisheries institutes where the specialists in various fields—economists, ecologists, oceanologists, toxicologists—can collaborate closely (Krasnov et al. 2014).

4 GIS-Based Approach

The development of the Geographic-Information System (GIS) and the creation of a database is another area in which the efforts of our scientists must be combined to provide a research basis for the distribution of productive forces in the Baltic-countries, the construction of free trade zones, ports, recreation centres, science parks, planning and protection of nature. The setting up of a central data bank to collect and centralize the various databases related to the state of the environment and natural resources, population levels, industry, transport, agriculture, etc. is also foreseen. The data would be updated by the central databank and accessible to subscribers for applied research. The Central European Data Centre in Budapest was founded in 1991 and links the nets-works serving regional environment centers in Hungary, Czech Republic, Austria and other countries. The Baltic University with its focus on deteriorating ecological situation will need a different center. The computer centre of Uppsala University (Sweden) and a few centres in Estonia have already linked up in an attempt to organize a regional distant data centre. An international seminar took place in at Kaunas V. Magnus University (December 1991) on the initiative of the authors. It was attended by representatives of all former Soviet Baltic Republics, and representatives from the Kaliningrad, Sankt-Petersburg, Byelorussia, Uppsala and Weber State Universities (USA, State Utah) also took part. An understanding was reached concerning the creation of the Baltic GIS and their prospective development. This foresees the development of the

GIS on the basis of agriculture, the development of international and national tourism, «white» health resort tourism and sanatoria, and a few other areas. After these had been defined and their coordinates specified, computers transformed them from digital into analogue form. This shows that the environmental atlas of the Baltic Sea basin ever-one needs can be produced. However, some time will pass before it can be completed and published, time in which experts must be trained in all regions and republics both to enter the data into the computer and to research the links between the data and to organize the data base. Uppsala University is organizing special courses to train GIS experts. After completion, all experts will receive corresponding documents and a free personal computer for recording and processing ecologic information. It is planned to base the Baltic GIS system on the topographic principle using a scale of 1:150,000–1: 120,000. Similar programs are also being developed with the support of UNO and UNEP. They serve the development of environmental protection in a free economy and enhance educational quality. It is difficult to over-estimate the contribution of integrated regional atlases showing in generalized form the environmental conditions, resource potential and perspectives for further development to the improvement of geographic education. Existing atlases are never adequate for this purpose owing to the long preparations before publication, misrepresentation of data, poor linkage, the predominant cartography component, and the «breaking up» of data. We can create corresponding atlases using a completely different, integrated methodological and methodical basis by including the GIS system (Krasnov 1995).

5 An Example of the Innovative Tourism Product

Current situation with the nature protected areas in the Kaliningrad region demonstrates that this potential could be used by the Russian citizens, more and more arriving to the region due to the geopolitical and economic situation (Kropinova 2009, 2011, 2013).

Until 2004, a system of protected natural areas in the Kaliningrad region included: 1 National Park, 8 state nature reserves of regional importance, 59 natural monuments of regional importance, two federal resort, 32 specially protected natural sites—wetlands.

The total area of protected areas in 2004 amounted up to 14 % of the total area of the region. Since 2011, efforts were made to restore the protected natural areas. By 2015 there were created the National Park, 1 natural park of regional importance and 11 state nature reserves of regional importance, including 2 complex (landscape) and 9 geological nature reserves (Agency on Nature protection 2015).

So the Faculties with specialization on tourism more and more introduce ecology and ecotourism into their curriculum. For instants, Ecology is a discipline of the Basic Component for the Educational Curriculum on the Faculty for recreation, tourism and physical training, on the Faculty for nature use, spatial development and town planning. Sustainable development and sustainable tourism is an

obligatory discipline of the regional component and ecotourism is most commonly introduced as a voluntary subject.

Teachers and students of the IKBFU are highly involved into the international projects, targeted at nature resources protection and sustainable use. By that tourism is the most common subject for study in most of the projects supported by EU programmes.

International projects dealing with eco-tourism issues with the participation of the Kaliningrad region:

- Creating a cross-border bike trails on old post road in the Curonian Spit: EuroVelo—Baltika.
- CROSSROADS—Lagoons as the cultural and historical crossroads of peoples in the South-Eastern Baltic area.
- Aropa 2.0./The AGORA 2.0—Heritage Tourism for Increased BSR Identity
- EcoRegion—The Baltic 21 EcoRegion project.
- CROSSROADS2.0.—Lagoons as crossroads for tourism and interactions of peoples of South-East Baltic: from the history to present.

Within the project Crossroads 2.0 there was special training for the international group of students organized. This group consisted of 45 students from Lithuania, Poland and Russia at first were given master-classes were given international lectures and master-classes by teaches and tourism experts from the all 3 countries. As a result of study the students have to present their projects on the sustainable use of the transborder nature resources. Among them there were proposals on the sport-parks, active-tourism routs, water-routs, recommended afterwards to the tourism companies.

Education for sustainable development within life-long learning projects: Example: "Project 'Water, nature and people in the disappearing landscape': On experience of rural tourism development in the Polessk district of the Kaliningrad region" (www.wildnet.ru).

In April 2014, the open-air museum of the Viking Age "Ancient Sambia" was opened in the National park "Curonian Spit". The museum was built in the framework of the international project "Lagoons as a crossroads for tourism and interaction between peoples of South-Eastern Baltic: from the history to Present", which is co-financed by the European Union.

The idea of creating this museum arose in I.Kant Baltic Federal University in 2005, when it was decided to set up an innovative tourism product, which would unite in itself an interactive component, a classical museum and would be new modern object of the tourist attraction of the region. The historical epoch of the Viking time (9–11th century) was selected as the main topic for open-air museum in the Kaliningrad region. The idea of creating this museum was not casual. There are wide network of similar museums in the Baltic Sea region, which includes the most western Russian region, Kaliningrad oblast. The nearest neighbor state, Poland, has five open-air museums, which reconstruct the Viking Age, and three of them are reconstructions of settlements of the Viking epoch. There are annual

events, festivals, historical and cultural reconstructions organized in these museums. The Kaliningrad region has the common history and heritage with the regions of Poland, Germany and Sweden, adjacent to the Baltic Sea. According to the results of archaeological excavations it was founded that several settlements of the Viking epoch were in the territory of the modern Kaliningrad region. Thus, according to the all preconditions, it was decided to reconstruct one of these settlements in the Curonian Lagoon adjacent area, representing the Vikings. This museum became the first in Russia open-air museum, of such type.

In the framework of the international project the technical documentation for the construction of the open-air museum on the site-visit Center National Park "Curonian Spit" of the Kaliningrad region was prepared. The interactive playground for children and "Time tipe" became the first stage of the museum. Museum "Ancient Sambia" is a reconstruction of an ancient settlement, which was located on the ancient settlement of Kaup, near town Zelenogradsk, and this fact is its uniqueness and value for studying the history of the region. In the museum visitors can touch the alive history of the region, can be returned back over a thousand years ago.

The museum was equipped with replicas of ancient tools, furniture and other staff, which is widely used for the exposition showing life of people in ancient times lived on the territory of present Lithuania, Poland and the Kaliningrad, adjacent to the Curonian and the Vistula Lagoons. In the museum it is possible to get an experience of ancient technologies of processing bone and amber, jewelry making, candle making, as well as food cooking. Plunge into the ancient culture and living history can also be possible through the wearing replicas of costumes and armor of the Viking Age.

The museum "Ancient Sambia" is organizing a mini-festivals "Days of ancient crafts" and small events in which visitors could enjoy and try a variety of craft activities, typical of the ancient historical epochs. Festivals can extend the range of handicrafts and interactive activities for tourists, which are not represented in the regular functioning of the museum. One of such festivals was held in the museum "Ancient Sambia" in June, 2015. During two days of the festival, the museum has attracted more than 2500 visitors.

Also, it is important to mention that open-air museum "Ancient Sambia" in the Kaliningrad region during its short history of existence, takes the 5th place of the 12 museums of the region. For the period less than a year it was visited by 7880 tourists. The open-air museum "Ancient Sambia", as an innovative tourist product competes with classical museums of the region and has a higher chance of reaching the leading positions in the rating.

Half of all tourists when they visit a foreign country primarily interested in local culture. It is also typical for local residents, many of whom are not have enough knowledge about the history of their region, as well as are not familiar with many traditions and cultural rituals. Such opportunity for tourists to learn the culture and alive history are given by the open-air museums, mainly historical and architectural, folk architecture, as well as ecomuseums. Cultural and ethnographic tourism is no less popular than other types of tourism.

Also, it is important to mention that the open-air museums should be seen from the standpoint of the development of innovation in tourism as the Center of Culture and the starting point for exploring by tourist or region or the country. Promotion of the museum as tourist sites is an important strategic task of interaction between museums and tourism for development the territory and increase the attractiveness of the regions.

The second example of a new type of the museums, allowing to learn through play and interactive communications is a new building of the World Ocean museum (Kaliningrad) called the "Planet Ocean". It is planned as a unique scientific-research complex that presents economy of knowledge for the mariculture development in the region. According to the architectural concept it will be a sphere that corresponds the form of the Earth. The museum depository and pavilions of the Naval Centre and Educational Centre have a cubic form associated with the unit of measurement of the Ocean (see The Museum of the World Ocean web-site. http://www.world-ocean.ru/en/the-planet-ocean-centre-project).

According to the scenario of the exposition members of the expedition ship "Planet Ocean" will learn a lot about the oceans: they will get information about the Planet mode on-line, they will go through the huge sea aquariums, will visit kino-planetary, the observatory, will participate in interactive sessions. The main important aspect is that of the exhibits will be presented in such a way that everyone will be able to touch them!

6 Future International Cooperation

Ecologic-economic research carried out on the basis of national and international programs in the basin of the Baltic Sea undoubtedly must activate and enhance the educational quality of students by stimulating their creative activity and cooperation in research projects. The next textbook must be based on the principal of ecologic-geographical courses («Ocean Econology», «Econosystem of the Baltic»). Special courses related to oceans, coasts, islands, utilization of nature, ecology, the economics of various industrial sectors, ecotechnology, ecotoxicology and environmental ethics, etc. must be presented by all geographical faculties (Ryden et al. 2003). The department of the Oceanology in particular and the Institute of Natural Use, Territorial Planning, and Urban Development Immanuel Kant Baltic Federal University in general could be one of the partner for the Baltic University Programme in this study.

7 Conclusions

The combined research into the environmental situation of the coastal regions performed by the scientists and students of Baltic universities should be used as a basis for elaborating joint recommendations for the utilization of natural resources

and the development of new technologies for the fishing and other industry. Special attention should be paid not only to environmental protection on the Baltic coast and in its basins, but also to reproduction in marine bays and inland basins. It is also necessary to orient decision-making towards the development the rational utilization of renewable natural resources (social and scientific tourism, health resort business, etc.). This means that the problems of training specialists in the fields of social and political ecology must be coped with and the potential for inter-national cooperation in the ecological education of the young people in the region should be considered.

References

Agency on Nature Protection. (2015). *Agency on protection, reproduction and sustainable use of the wildlife and forests of the Kaliningrad region*. http://alh39.ru/ (Last Accessed January 12, 2016).

Barnett, P., Fiore, S., & Wingert-Playdon, K. (2010). Interdisciplinary goals, disciplinary faculty: Bridging the gap with faculty learning communities. *Academic Leader, 26*(10), 3–5.

Cotton, D., Bailey, I., Warren, M., & Bissell, S. (2009). Revolutions and second-best solutions: Education for sustainable development in higher education. *Studies in Higher Education, 34* (7), 719–733.

Fedorov, G., & Krasnov, E. (2012). Agriculture in Kaliningrad. Case Study Russia. In C. Jakobsson (Ed.), *Ecosystem health and sustainable agriculture* (pp. 448–450). Uppsala University: The Baltic University Press.

Ionov, V., & Kropinova, E. (2010). Practical experience of International Education Projects realization. *The Baltic Region 3*, 92–97 (in Russian).

Krasnov, E. (1995). Integrated ecological and business management study at higher education institution in the Kaliningrad Area. In J. Köhn & U. Schiewer (Eds.), *The future of the Baltic Sea* (pp. 271–282). Malburg: Metropolis-Verlag.

Krasnov, E., Karpenko, A., & Simons, G. (2014). Crisis management challenges in Kaliningrad. In E. Krasnov, A. Karpenko, & G. Simons (Eds.). Ashgate Publ.: UK.

Kropinova, E. (2009). Zoning of the Kaliningrad Region for the purpose of tourism and recreation development of trans-border cooperation. *Tiltai, 3*, 117–128.

Kropinova, E. (2011). Quality education for tourism and services—Is the basis for the sustainable development of the area. *Higher Education in Russia*, *5*, 99–104 (in Russian).

Kropinova, E. (2013). Cooperation between Russia and the EU in the field of innovation development of tourism as an example of cross-border cooperation program 'Lithuania-Poland-Russia". *Baltic Region, 4*(18), 48–57. (in Russian).

Ryden, L., Migula, P., & Andersson, M. (2003). Environmental science. In L. Ryden, P. Migula, & M. Andersson (Eds.) (824p). Uppsala: The Baltic University Press.

Wildnet. *Ecological and Education Center "wildlife sanctuary"*. http://www.wildnet.ru (Last Accessed January 12, 2016).

Authors Biography

Eugeny Krasnov Prof. Eugeny Krasnov, Doctor of geology, Emeritus Professor of RF, The holder of the International Prize "For the Baltic Sea Future" (1997). The chair of the Doctoral theses Council in the I.Kant Baltic Federal University, the Member of the World Cultural Council in Mexico. Honorary member of the Russian Geographical and Paleontological Societies.

Elena Kropinova Associate Prof. Elena Kropinova holds a degree in Doctor on Economics from the Pier Mendes France University (Grenoble, France) (2003), PhD on Geography from the Kaliningrad State University (1997) (Russia). Specialization in Geography (1993). She is currently a Vice-director on research in the Museum of the World Ocean and an Assoc. Prof. at the Institute on recreation, tourism and physical education of the I.Kant Baltic Federal University, Kaliningrad, Russia.

Towards a Social Ontology on Sustainable Development in CUT: Understanding Stakeholder Perceptions

Awuzie Bankole, Emuze Fidelis and Ngowi Alfred

Abstract

Successful implementation of Sustainable Development (SD) in Higher Education cannot be achieved through distinct knowledge and operational silos. Rather, the storyboard of success shows the importance of stakeholder contributions. However, achieving a consensus among stakeholders has proven to be a herculean task when power relations are uncertain. Such lack of consensus accentuates a need for the evolution of an SD based social ontology within a University system. As a first step towards achieving such ontology, it is imperative that the perceptions of these stakeholders are gauged and understood. This is the central objective of this study. In this study, the Central University of Technology, Free State (CUT) is used as an exemplar to explore the existence of diverse stakeholder perceptions and the impact of such on the attainment of expected implementation outcomes. This study obtains data through semi-structured interviews from identified stakeholders within the CUT. Observations from the data confirmed the prevalence of diverse perceptions on the definition

A. Bankole (✉) · E. Fidelis
Department of Built Environment, Central University of Technology, Free State, South Africa
e-mail: bawuzie@cut.ac.za

E. Fidelis
e-mail: femuze@cut.ac.za

N. Alfred
Faculty of Engineering and Information Technology, Central University of Technology, Free State, South Africa
e-mail: angowi@cut.ac.za

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_30

of sustainability and the components of SD as well as its expected outcomes. The findings from this study would assist in the evolution of an SD based social ontology within the University by harnessing the identified perceptions of the various stakeholders.

Keywords
Higher education institutions · Social ontology · Stakeholders · Sustainable development

1 Introduction

The role of Higher Education Institutions (HEI) in engendering Sustainable Development (SD) within the society has been elucidated in relevant literature (Cortese 2003; Krizek et al. 2012). Such roles originate from their time-honoured positions as institutions situated at the forefront of knowledge creation (Stephens et al. 2008). HEIs are regarded as microcosms of the society (Lozano et al. 2013). They provide a platform for applying suggested solutions to societal challenges. Issues concerning SD have continued to reverberate within society. Owing to the previously stated reasons, HEIs are being increasingly looked upon to provide society with the wherewithal to achieve successful SD implementation. Such demands have led to the adoption of various initiatives such as the Education for Sustainable Development (ESD) mantra, amongst others. Central to this mantra, is the modification of extant curricula, as it pertains to teaching, learning, research and university operations, to suit the attainment of SD requirements. HEIs in Sub-Saharan Africa (SSA) region seem to have secured a buy-in into this agenda. This is not only evident in the plethora of HEIs that signed up to the 2009 declaration entitled 'Sustainable Development in Africa-The Role of Higher Education' at the 12th General Conference of the Association of African Universities (AAU) in May, 2009 (Escrigas et al. 2011), but also in the preponderance of HEIs which have since expressed their aspirations to become Sustainable Universities (SU). In such HEIs, this aspiration has transformed from mere aspirations to policy statements. Also, the development of implementation frameworks has been observed. Although the participation of the Central University of Technology, Free State (CUT) in the aforementioned declaration is unclear, its aspiration to become an SU has been buttressed by its announcement of a strategic vision, a policy, and the subsequent inauguration of the Sustainability Implementation Framework (SIF) (CUT 2012). Through these mechanisms, which were inaugurated in 2011, CUT set itself up for the advancement of SD within its campuses. However, five years into the implementation of the ten year strategic plan, implementation at CUT has continued to suffer from under-reportage of performance.

Contemporary literature buttresses the significant impact of stakeholder commitment and involvement in achieving successful implementation varying initiatives (Yang et al. 2009). This implies that the commitment of various stakeholders within CUT is imperative for securing expected SD implementation performance. There is a need for the development of a shared understanding of the SD agenda at CUT. The absence of such understanding has been identified as a barrier to the adoption and implementation of organizational objectives (Ralph and Stubbs 2014; Sammalisto and Lindhqvist 2008). The bid to develop this understanding among stakeholders is often negated by the multiplicity of perceptions, which drive the development of diverse understandings about a particular phenomenon within a community. To resolve such issues, especially as it pertains to the implementation of an agenda, there is a need to evolve a social ontology among stakeholders in CUT. In other words, this study seeks to contribute to the evolution of an SD based social ontology among distinct stakeholders in CUT. It intends to achieve this by exploring the existing perceptions of these stakeholders on the SD agenda with a view to identifying and explicating common grounds identified from the narrative emanating from such an exploration. It is expected that the identification of commonalities from the divergent perceptions of these stakeholders will contribute immensely to consensus building regarding what SD entails for CUT and how it can be actualized.

2 Literature Review

2.1 A Social Ontology for SD in HEIs

The term 'ontology' is derived from two Greek words, '*onto'* (being) and '*logos*' (study or science) hence implying, the science or study of being (Latsis et al. 2013). '*Being*' in this sense is used to refer to either entities or things that are in existence or what are to exist as well as what such entities have in common. Therefore, a social ontology can be referred to as a reflection of the shared beliefs and perceptions existing within a social entity (usually a community) pertaining to a social reality (Latsis et al. 2013, Edum-Fotwe and Price 2009). The applicability of the social ontology concept within a societal context is based on the presupposition that social reality evolves from a society's collective imposition of functions on physical reality (Searle 2006). This kind of function is referred to as a status function (Thomasson 2003). In presenting an instance of status functions, an example of a piece of paper which is collectively accepted within a society as constituting a medium of exchange, is rendered. However, three components are required to engender such reality, namely; collective intentionality, assignment of primary functions, and constitutive rules and procedures (Searle 2006).

According to Searle (2006), collective intentionality is not only used to connote intent but also beliefs, hopes, desires, emotions, perceptions, etc. shared by a group of individuals (collective). He reiterates the power of individuals to assign functions

to objects for specific purposes, even when the object did not possess the physical traits to carry out the assigned functions. Similarly, constitutive rules or procedures are rules established to ensure conformance to the social realities produced through collective intentionality and assignment of functions.

In affirming the significance of social ontology in understudying social realities within a societal context, Edum-Fotwe and Price (2009) reiterate that the concept serves to portray extant situations in a particular societal context albeit at an abstract level. Affirming that it highlights the kind of interactions among individual values which have led to these situations (social realities), they maintain that social ontology will enable an in-depth understanding of the attributes of individuals within that societal context. Their argument is premised upon the assumption that social realities do not evolve in a vacuum, but rather it results from the robust interaction of individual values within a particular societal context. This implies that the social ontology of a particular community is a mere reflection of the aggregate choices of the individual constituents of that community.

From the foregoing, it can be proposed that an HEI's desire to deliver on its expected SD outcomes can only be successful if there is shared understanding among various stakeholders regarding what these outcomes entail and how they can be achieved. This is especially so in HEIs that has been previously described as microcosms of the society with various stakeholder groups with diverse understanding of issues. Achieving such shared understanding is critical to the development of a social ontology on SD implementation at CUT.

2.2 Sustainability@CUT

Driven by the Higher Education Policy in South Africa, which is aligned with national strategic commitments to SD, CUT proceeded to state its aspiration in making significant contributions towards the attainment of SD commitments (CUT 2012). It is pertinent to note that these commitments are based on the global societal shift towards SD. In a show of its commitment to the sustenance of the ethos of SD, CUT in 2010/2011 embarked on a transformational journey towards becoming a Sustainable University of Technology (SUoT). This transformation was built around the following context specific features, namely; its place as a South African public institution, and its nature as a University of Technology (UoT). The former makes it imperative for CUT to adopt and support the national commitments and development aspirations of the government and citizenry of the South African nation, especially as it concerns making contributions to science, technology transfer, and education. The latter is concerned with the UoT's institutional context. This implies that the decision making apparatus at CUT would be centred upon:

- Granting of special consideration to the development and transfer of substantial contributions towards the attainment of global, regional, national and local sustainability through a modification of the extant curriculum;

- Engendering sustainability ethos as it pertains to its resource consumption and conservation practices with the intention of contributing to the reduction in institutional ecological footprint;
- Promoting institutional governance and management alternatives, which provide support for the enthronement of affordable, and durable risk mitigation solutions that can be transferred to other sectors of the society, in the conduct of their daily operations, and
- Adopting an integrated approach to SD progress through partnership arrangements.

CUT's SD commitment to attain its SUoT aspiration by the turn of the decade is encapsulated in Fig. 1. But, five years into implementation, studies investigating SD implementation across various facets of CUT's activities have reported bleak implementation performance (Awuzie et al. 2015; Awuzie and Emuze 2015). Findings from these studies indicate that Business as Usual (BAU) has continued. It appears that the transformation mantra does not enjoy the kind of support it requires to sustain successful performance from various stakeholder groups. Findings from these previously mentioned CUT focused studies have sought to align with extant studies concerning SD implementation in HEIs in attributing incidents of poor implementation performance to a plethora of organizational and financial factors (Ralph and Stubbs 2014; Stafford 2011; Svanström et al. 2012; Velazquez et al. 2005).

3 Methodology

This study adopts a case study research design. The case study research design is renowned for its efficacy in studies attempting to study a phenomenon within its natural context, hence its adoption in this study (Yin 2013). This aligns with the scope of this particular study, which seeks to explore stakeholder perceptions concerning SD implementation (phenomenon) within the CUT (context). The use of face to face semi-structured interviews contributed immensely to obtaining the perceptions of the identified stakeholder groups. As an elicitation technique, semi-structured interviews support the elicitation of the interviewees' weltanschauung as it pertains to the subject matter whilst enabling the interviewer to maintain some degree of structure (King and Horrocks 2010). Furthermore, it provided an insight into how these interviewees have come about developing such weltanschauung.

Considering the centrality of the interviewees' opinions to attaining the study's objective, the choice of this technique made it possible for them to serve as participants in the research. This enabled them to actively shape the course of the interview sessions through their responses instead of proffering passive responses. Also, the avoidance of the latter scenario prevented the interviewers from imposing their own version of reality on the interviewees.

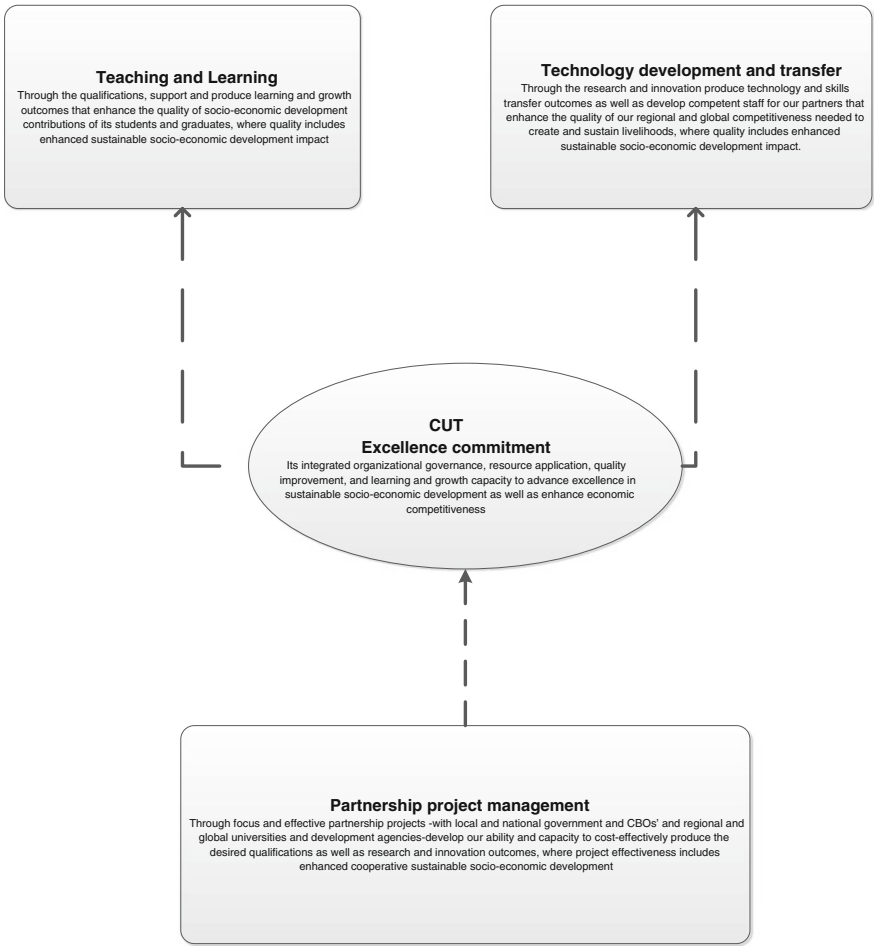


Fig. 1 Important elements of CUT's integrated commitment to excellence in sustainable socio-economic development. *Source* CUT (2012)

The interviewee recruitment exercise was preceded by an identification of stakeholders. A perusal of the SIF document revealed the various stakeholder groups who were responsible for contributing either directly or indirectly to the achievement of CUT's transformational aspiration. For this study, only stakeholder groups who had direct impact on the HEI's SIF were adopted. Accordingly, five stakeholder groups were identified. These groups consist of the following, namely; academic staff, non-academic staff, students, (postgraduate and undergraduate), University management staff, and Infrastructure Delivery Partners (IDP).

The categories of stakeholders listed above are to a large extent self-explanatory, perhaps with the exception of the Infrastructure Delivery Partners. Recently, CUT has been involved in a major infrastructural development exercise in its two main

campuses. IDP as used in this context refers to consultants, contractors and sub-contractors. The authors ascribed the same stakeholder status to staff of CUT's in-house Facilities Maintenance/Management staff for obvious reasons. For the sake of expediency, the student stakeholder group was delineated along undergraduate student and postgraduate student lines. The University Management staff consisted of staff members holding administrative portfolios pertaining to teaching and learning, research and operations.

In the aftermath of this stakeholder identification and categorization, the researchers proceeded on an interviewee recruitment drive. A mixture of purposive, convenience and snow-ball sampling techniques were adopted (Denzin and Lincoln 2008). Prospective interviewees were approached through a plurality of ways. For prospective interviewees belonging to the respective stakeholder groups with the exception of the students' stakeholder group, emails were sent to them soliciting their participation in the study as interviewees. The recruitment of interviewees lasted for a period of five months (June–October, 2015). The interviewee demographics are indicated in Table 1.

At the last count, a total of twenty-three (23) interviewees were successfully recruited and interviewed. The interview sessions ran concurrently with the recruitment exercise due to time pressures. Time constraints were experienced during the conduct of this study as there seemed to be a high degree of apathy among the stakeholders to the SD implementation process at CUT. For example, varying stakeholder groups were often not forthcoming in participating in the interview sessions. Therefore, the sample cannot claim to be truly representative when the representation of the non-academic staff is considered. However, this limitation does not undermine the credibility, trustworthiness and reliability of the findings based on the instruments applied in data collection and analysis—semi-interviews and Qualitative Content Analysis (QCA).

Questions asked during these interview sessions focused on gaining an insight into the perceptions of the identified stakeholder groups as it pertained to:

- Shared understanding of the dual concepts of Sustainability and Sustainable Development;
- Level of awareness of the CUT's Sustainable Development agenda, and
- Expected outcomes from CUT's Sustainable Development agenda.

The interview sessions lasted for an average of twenty-five minutes each. The interview sessions were tape recorded, with the permission of the interviewees and subsequently transcribed. Upon transcription, the identities of the interviewees were anonymised for confidentiality purposes. Thereafter, the transcripts were analysed thematically using QCA (Denzin and Lincoln 2008). The use of the QCA approach allowed for the defragmentation of the data originating from the interviews into manageable categories otherwise referred to as themes thus enabling easy analysis. In carrying out the analysis, the questions listed above were utilized as pre-set themes. Steps taken in the analysis included the reading and re-reading of the transcripts, the development of preliminary categories using the aforementioned

Table 1 Interviewee demographics

No	Designation	Code	Stakeholder group					
			Academic staff	Non-academic staff	Students (Undergraduate)	Students (Postgraduate)	University management staff	Infrastructure delivery partners
1	Maintenance manager	MM						X
2	Clerk of works	CW						X
3	General foreman	GF						X
4	Senior lecturer	SL	X					
5	Lecturer 1	L1	X					
6	Lecturer 2	L2	X					
7	Director (Academic unit)	DAU					X	
8	Infrastructure delivery consultant	IDC						X
9	Junior lecturer 1	JL1	X					
10	Junior lecturer 2	JL2	X					
11	Dean of faculty	DoF					X	
12	Sustainability advisor	SA					X	
13	Construction manager	CM						X
14	Technical assistant	TA		X				
15	Undergraduate student 1	US1			X			
16	Undergraduate student 2	US2			X			

(continued)

Table 1 (continued)

No	Designation	Code	Stakeholder group					
			Academic staff	Non-academic staff	Students (Undergraduate)	Students (Postgraduate)	University management staff	Infrastructure delivery partners
17	Undergraduate student 3	US3			X			
18	Undergraduate student 4	US4			X			
19	Undergraduate student 5	US5			X			
20	Postgraduate student 1	PS1				X		
21	Postgraduate student 2	PS2				X		
22	Postgraduate student 3	PS3				X		
23	Postgraduate student 4	PS4				X		

Source Authors' fieldwork (2015)

pre-set themes (Taylor-Powell and Renner 2003; Wildemuth and Zhang 2009). The responses contained in the transcripts were then coded according to the established themes. Thereafter, the themes were reviewed to ensure the suitable nature of the categorization applied.

4 Results and Analysis

In this section, the findings observed from the data are discussed in accordance with the pre-set themes.

4.1 Shared Understanding of Sustainability and Sustainable Development

CUT's desire to develop a social ontology towards SD implementation rests on the troika of collective intentionality, functional assignment and constitutive rules. A shared understanding among stakeholders concerning the phenomenon is central to an evolution of the aforementioned troika. This much was admitted to by three different interviewees, SL, DAU and SA. According to DAU, '…. *it takes us back to what I think the fundamental issue is,… do we have a shared understanding of SD*?" In furtherance to this, he advises "… *so I think what will be quite fundamental in your study, in my opinion, is what is the definition that you are providing with regards to SD and how are the people (stakeholders) responding to these endeavours*?" Corroborating DAU's assertions, SA identifies the need for proper education of stakeholders on what SD entails stating that "*proper education of your internal staff on what is meant by sustainability, because everybody understands it differently*". These statements by DAU and SA literarily set off the discourse on whether a shared understanding exists in CUT about the definition of SD.

In fact all the interviewees hinted of different definitions of the SD concept. Interviewees such as DAU, SA, CM, PS1, PS2, SL and IDC were able to describe SD as it obtains in the public space, although not without some reservations. For instance, whilst acknowledging the supposedly generic definition of SD, SL who doubles as an academic and a university management staff, in his capacity as a faculty research manager, insisted that his management position makes him see SD differently. According to him, "…*a research manager should look at sustainable research and from that side, I think that what we should consider is looking more into continuity of research, research applications, and the relationship between the research and the industry and the community…so these are the elements of sustainable development when it comes to research management side, from my own perspective*". He however admitted to an understanding of the SD mainstream definition when speaking from an academic position with respect to his specialism. In his own rendition when asked to share his own understanding of SD and sustainability, DoF maintained that the SD and sustainability from the CUT

perspective bothered on how to ensure a steady enrolment of students into the HEI. Additionally, he stated that the major difficulty was how to get this enrolment to provide for financial sustainability for the HEI. And as such, he advocated for improved program offering to the prospective students in line with the current realities of the employment market place.

In a similar vein, SA repeated the mainstream definition of SD by stating that "*Well, SD just like the Bruntland report states focuses on development, how are we going to develop for our current needs without depleting your resources so that your future generations can also be sustained. Sustainability for me is the process of our development, how do we start towards getting to that point of being sustainable. So that process is very important when we talk about SD and the development."* However, during the course of the interview, SA admitted that the prevailing perception within the CUT on SD was focused on the financial (economic aspect) "*Right now, people are just seeing sustainability as the financial element. You know like… We need to save. And it is not so much focused on the environmental and social, so right now, I am working with the team to get them to understand the importance of all three and not just one"*. However, during the course of the interview, interviewee SA was found to be hammering on the environmental and financial aspects of SD, mainly energy consumption and conservation as well as waste management, thus implying that this was an aspect she was keen on mainstreaming.

Conversely, stakeholders within the IDP group displayed an understanding of the concept which was also at variance with most of the opinions previously espoused by representatives of the other groups. Majority of the stakeholders in this group indicated a grounded knowledge and understanding of SD, but expressed their willingness to champion it, only if the client (in this case CUT) demands for it through proper specification in project documents. Interviewees in this category were mostly representatives of consulting and contracting concerns to whom certain functions concerning the delivery of built assets at CUT had been outsourced. In a nutshell, they implied their willingness to abide by the existing social reality construct in CUT, despite their personal experiential knowledge. This was evident in CM's assertion where he described himself as a Sustainability/Sustainable Development champion by stressing that "*…I have spent the last 18 years in the UK so sustainability has been pretty much at the top of my agenda. I am a qualified BREEAM assessor, and I was sustainability champion for three corporate organisations over there, so it's quite a high for me*". However on his present engagement at the CUT, he states "*…I mean it's at the top of my agenda but the problem is that it is not at the top of the client's agenda or perhaps most clients' agendas certainly in South Africa yet."* Similarly, GF insisted that aspects that were specified in the project contracts such as ensuring an estimated 30 % spend within the CUT's local environment was being adhered to.

From the perspectives of the students, undergraduate and postgraduate students alike, as well as TA, and CW, the term SD was associated with the need to ensure greater efficiency in energy and water usage at CUT. Obviously, this notion is as a result of the communication emanating from the quarters with authority pertaining

to SD matters at the CUT (Djordjevic and Cotton 2011). Such communication always expressed concern on the inefficiencies experienced in the areas of resource consumption, particularly energy and water.

Summarily, it can be deduced that diverse understanding of SD exists among CUT's stakeholders. Perhaps, this is a significant contributor to the low implementation performance levels being experienced, therein.

4.2 Level of Awareness of the CUT's Sustainable Development Agenda

According to Mader et al. (2013), optimal levels of awareness concerning transformational concepts such as SD are central to the entrenchment of such ideas into the organizational fabric of HEIs. Without such degree of awareness, securing the buy-in and commitment of stakeholders and attainment of successful implementation may be difficult. It was therefore astonishing to observe that majority of the stakeholders interviewed claimed knowledge of the concepts of sustainability and SD, their varied definitions notwithstanding, as well as the existence of CUT's SD Charter; but they feigned ignorance on what its components and the SIF entailed. Also, three of the undergraduate student interviewees, US3, US4, and US5 who were carrying out their studies within the realm of the built environment at CUT affirmed that their knowledge of the concepts was as a result of their research topics. DAU whilst affirming that there was a limited knowledge concerning what actually constituted SD, reiterated that this was not peculiar to the HEI's stakeholders. He stressed that "*….so it is fair to say as a general observation, people have a limited observation of SD and I think that this is primarily due to its origination in the public space and generally, how it is being communicated*". He maintained that given the seeming dominance of environmental issues in the communication of SD, a greater proportion of individuals tend to neglect the concept, owing to its inability to take care of the social and financial (economic) aspects of their daily lives.

Certainly, this constitutes a major challenge to the development of a social ontology. It is obvious that CUT's SD charter has fallen victim to organisational encumbrances occasioned by ineffective communication. For the avoidance of doubt, the core statement of the SD charter as stated in its policy document indicated that as an SU, CUT aspires to "*….become a teaching, research and learning environment which maximizes and mainstreams environmental, economic and social sustainability in all its operations and educational activities*" (CUT 2012). Also the SIF provides a guideline of implementation with associated outcomes. Of interest in the plethora of deliverables was the desire to train/hold induction of at least 800 staff and students on SD matters over a three year period, 2011–2014. This would have accelerated the integration of the SD principles into the fabric of CUT to support shared understanding of the relevant concepts. Unfortunately, observations originating from conducted interviews indicate that this has not been done and as such, the attainment of a shared understanding among the stakeholders remains an aspiration.

5 Expected Outcomes from CUT's Sustainable Development Agenda

The bid to evolve a social ontology, normally originates from the identification of a collective expectation of certain outcomes (Bickhard 2008). Such outcomes will lead to improved buy-ins and commitment from members of a given community. Such expectations make it easier to engender behavioural change through constitutive rules and procedures. The identification of such outcomes makes the development of a social reality, which is centred on the attainment of these outcomes less challenging. As such, the interviewers sought to identify the expected outcomes of a robust SIF from the interviewees. One of the cardinal issue that was brought to bear as an expected outcome was the issue of Indoor Environmental Quality (IEQ). The interviewees from the undergraduate, postgraduate, academic, and non-academic groups stated that the IEQ in their lecture halls and the hall ways were inappropriate and did not conform to the guidelines for SD as described to them by the interviewers during the interview sessions. They opined that this led to increased usage of electricity as the ventilation was poor and the natural lighting was impossible. When asked if this was the case in recently completed buildings at the CUT, they affirmed that BAU is the norm. Members of the academic staff also inferred that the processes of staff recruitment as experienced by them did not accord considerable weighting to the prospective employees on the issue of attitude or understanding of sustainability and SD.

According to an interviewee, CM, little is being achieved in terms of integrating the SD agenda into the provision of built assets on campus. According to him, "*…So using this project as an example, the student accommodation, it's got some features you can call sustainable…But it could have had an awful lot more. It could have had solar on the top, you could have insulated it better, you get what I mean. Natural lighting would have been better, we could have upped the insulation for the sun but in fact this building when it was originally tendered had insulation inside the façade which was taken out for value engineering. So now you think to yourself, for the short term, for the project, for the build, you've saved some money but in the long term, you've got probably I can't remember the difference but probably three or four times the capital expenditure over the life of this building lost in the value of power consumption to heat because you've got to heat this up now half year when the Free State is freezing cold and we have radiant heating panels in every room in the accommodation which isn't really great.*" His statement indicates what the supposed expectations should be about a truly sustainable building. However, issues relating to initial cost outlays continue to deter the actualization of such buildings. This observation draws attention to the need for a shared understanding. It is apparent that this stakeholder had a different understanding of what SD is and what its outcomes should entail from what the client had on the same phenomenon.

6 Conclusion

The role of HEIs in fostering SD has been observed. HEIs being microcosms of the society have sought to transform themselves into SU and then share the knowledge created during the process with other sectors of the society. CUT happens to be one HEI with such aspiration. Because of its aspiration, CUT initiated an SD policy and an implementation framework (SIF) with a timeline of a decade. However, a social ontology has been described as imperative for SD implementation success. In consideration of the criticality of a common perception among various stakeholders to the evolution of a social ontology on SD implementation, this study explored the perceptions of various stakeholder groups within the HEI. The study observed that there was indeed a variety of perceptions regarding SD definition and/or understanding. The lack of shared understanding/interpretation may be impacting SD implementation performance at CUT. The study indicated that despite the presence of a policy that is supported with a documented framework, there is a low level of awareness among stakeholders regarding internal SD policy and framework at CUT. Furthermore, no common ground was identified among the various stakeholders interviewed thus implying the difficulty of achieving a social ontology. It is suggested that increased stakeholder awareness, and enlightenment should be adopted by CUT, if SD is to become second nature in the institution.

It is hoped that this study will contribute to the evolution of a social ontology, which will consequently engender the successful implementation of SD at the institution. Also, a paucity of studies into the impact of sociological factors on SD implementation in HEIs, particularly in SSA has been noted. It is expected that this study will provide the theoretical basis upon which such studies will be premised. Further studies pertaining to the development of a robust implementation framework based on a common social ontology among stakeholders within CUT and other HEIs in South Africa are advocated. Future studies should incorporate statistical computations through the use of alternative techniques whilst building on the findings of this study.

References

Awuzie, B. O., & Emuze, F. A. (2015). An identification of organizational factors affecting sustainable development in a South African University. In F. A. Emuze & J. J. Smallwood (Eds.), *Proceedings of the 4th Construction Management Conference,* Port Elizabeth, South Africa.

Awuzie, B. O., Emuze, F. A., & Ngowi, A. B. (2015). Towards sustainable procurement of infrastructure in a South Africa University of Technology. In C. Egbu (Ed.), *Going North for Sustainability: Leveraging Knowledge and Innovation for Sustainable Construction and Development.* London South Bank University, London, UK: IBEA Publications.

Bickhard, M. H. (2008). Social ontology as convention. *Topoi, 27*, 139–149.

Cortese, A. D. (2003). The critical role of higher education in creating a sustainable future. *Planning for Higher Education, 31*(March–May), 15–22.

CUT. (2012). *Sustainability development report*. Bloemfontein: Central University of Technology.

Denzin, N. K., & Lincoln, Y. S. (2008). *Collecting and interpreting qualitative materials*. California: Sage.

Djordjevic, A., & Cotton, D. (2011). Communicating the sustainability message in higher education institutions. *International Journal of Sustainability in Higher Education, 12*(4), 381–394.

Edum-Fotwe, F. T., & Price, A. D. (2009). A social ontology for appraising sustainability of construction projects and developments. *International Journal of Project Management, 27* (2009), 313–322.

Escrigas, C., Polak, E. E., & Jegede, O. (2011). The promotion of sustainable development by higher education institutions in Sub-Saharan Africa-Survey report. GUNi/IAU/AAU.

King, N., & Horrocks, C. (2010) *Interviews in qualitative research*. London, California, New Delhi,, Sage.

Krizek, K. J., Newport, D., White, J., & Townsend, A. R. (2012). Higher education's sustainability imperative: How to practically respond? *International Journal of Sustainability in Higher Education, 13*(1), 19–33.

Latsis, J. S., Lawson, C., & Martins, N. (2013). Introduction: Ontology, philosophy and the social sciences. In C. Lawson, J. S. Latsis, & N. Martins (Eds.), *Contributions to social ontology.* Oxford: Routledge.

Lozano, R., Lukman, R., Lozano, F. J., Huisingh, D., & Lambrechts, W. (2013). Declarations for sustainability in higher education: Becoming better leaders, through addressing the university system. *Journal of Cleaner Production, 48*(1), 10–19.

Mader, G. S., Dzulkifli Abdul Razak, C., Cebrián, G., Grace, M., & Humphris, D. (2013). Organisational learning towards sustainability in higher education. *Sustainability Accounting, Management and Policy Journal, 4*(3), 285–306.

Ralph, M., & Stubbs, W. (2014). Integrating environmental sustainability into universities. *Higher Education, 67*, 71–90.

Sammalisto, K., & Lindhqvist, T. (2008). Integration of sustainability in higher education: A study with international perspectives. *Innovative Higher Education, 32*(4), 221–233.

Searle, J. R. (2006). Social ontology some basic principles. *Anthropological Theory, 6*(1), 12–29.

Stafford, S. L. (2011). How green is your campus? An analysis of the factors that drive universities to embrace sustainability. *Contemporary Economic Policy, 29*(1), 337–356.

Stephens, J. C., Hernandez, M. E., Román, M., Graham, A. C., & Scholz, R. W. (2008). Higher education as a change agent for sustainability in different cultures and contexts. *International Journal of Sustainability in Higher Education, 9*(3), 317–338.

Svanström, M., Gröndahl, F., Holmberg, J., Lundqvist, U., Svanström, M., & Arehag, M. (2012). The university and transformation towards sustainability: The strategy used at Chalmers University of Technology. *International Journal of Sustainability in Higher Education, 13*(3), 219–231.

Taylor-Powell, E., & Renner, M. (2003). Analyzing qualitative data. In University of Wisconsin–Extension (Ed.), Wisconsin: University of Wisconsin–Extension, Cooperative Extension.

Thomasson, A. (2003). Foundations for a social ontology. *Protosociology, 18*(19), 269–290.

Velazquez, L., Munguia, N., & Sanchez, M. (2005). Deterring sustainability in higher education institutions: An appraisal of the factors which influence sustainability in higher education institutions. *International Journal of Sustainability in Higher Education, 6*(4), 383–391.

Wildemuth, B. M., & Zhang, Y. (2009). Qualitative analysis of content. In B. M. Wildemuth (Ed.), *Applications of Social Research Methods to Questions in Information and Library Science.* Westport, CT: Library Unlimited.

Yang, J., Shen, G. Q., Ho, M., Drew, D. S., & Chan, A. P. C. (2009). Exploring critical success factors for stakeholder management in construction projects. *Journal of civil Engineering and Management, 15*(4), 337–348.

Yin, R. K. (2013). *Case study research: Design and methods*. California: Sage Publications.

Consumption, Production… or Perfection? Exploring Approaches to Carbon Footprinting in Higher Education Institutions

Oliver J. Robinson, Simon Kemp and Ian D. Williams

Abstract

Organisations of all types are significant contributors to global anthropogenic greenhouse gas emissions. Currently, the carbon emissions of organisations are typically assessed through hybrid environmentally extended input-output—life cycle analysis. The design of these models means that double counting is inherent and, were all institutions to report their carbon footprint, the cumulative figure would be grossly inflated. Knowing the full extent of environmental impact is important in the decision making process to implement sustainability initiatives. However, on the basis of comparing with peers and contributing to national carbon accounts, the model falls short of requirements. For universities, where activity is dominated by the consumption of resources, producing and reporting the carbon footprint is plagued by potential double counting, as well as vast data collections which are too cumbersome for institutions to manage. To find the most suitable approach for higher education, this paper explores the attributes of the organisational carbon footprinting methodologies available to simultaneously avoid double counting and lessen data management issues. The former can be eradicated if activities are allocated on either a consumption or production basis; however footprinting is streamlined for universities if a production based footprint is chosen. Universities should not defer from their responsibility to sustainable consumption and so for internal purposes, efforts to understand the full breadth of emissions in which they indirectly influence are deemed important.

O.J. Robinson (✉) · S. Kemp · I.D. Williams
Centre for Environmental Science, University of Southampton, Lanchester Building, University Road, Highfield, Southampton, Hampshire SO17 1BJ, UK
e-mail: ojr1g08@soton.ac.uk

W. Leal Filho et al. (eds.), *Handbook of Theory and Practice of Sustainable Development in Higher Education*, World Sustainability Series,
DOI 10.1007/978-3-319-47889-0_31

Keywords
Carbon footprint · Greenhouse gas · Consumption · Production

1 Introduction

Organisations are becoming increasingly aware of their responsibility to reduce carbon emissions both within their direct control and as a result of their supply chain. Carbon management involves the act of 'managing' and 'measuring' the greenhouse gas (GHG) emissions from organisations' activities focussing predominantly on two GHGs, CO_2 and CH_4 (Williams et al. 2012). One key group from which carbon emissions have risen steadily is Higher Education (HE). Globally, the sector exceeds 178 million people, representing 29 % of the global university-age demographic, having grown 200 fold over the course of the 20th century (Schofer and Meyer 2005) and estimated to rise to 262 million by 2025 (Pike 2012). The number of institutions that exist to accommodate students now equals some 17,000 around the world. The United Kingdom (UK) HE sector (which encompasses 129 universities) has experienced a 3.9 % increase in emissions between 2005 and 2010 and is under increasing pressure to deliver progress towards the Climate Change Act 2008 target.[1] As a result, the Higher Education Funding Council for England (HEFCE) in 2010 introduced an interim target to reduce emissions by 34 % below 1990 levels by 2020 (Higher Education Funding Council for England 2010b). Six years into the commitment period, universities have struggled to change their operating procedures to foster lasting change as a result of ambitious targets and institutional inertia (Robinson et al. 2015).

Whilst current targets focus on scope 1 and 2 emissions (those that occur within the organisational boundary, directly, through fuel usage and indirectly, through electricity consumption), it is clear that universities influence a whole host of indirect activities that in the main, go unreported. These 'scope 3' emissions occur outside of the organisational boundary and have in fact been found to account for the majority of GHG releases, significantly dwarfing the contribution of Scope 1 and 2 sources (Ozawa-Meida et al. 2011). Environmental practitioners often labour to identify reliable datasets to quantify the emissions of these activities, as much of the data is held externally or hard to access. To compound these issues, the reliability of the data leads to a lack of confidence in reported values (often cited as the most common reason for avoiding reporting them (Cummis et al. 2013)). UK HEIs have been reporting on environmental metrics to the Higher Education Statistics Agency (HESA) for some time through the Estate Management Record (EMR) but many entries do not receive high response rates from institutions. Through this

[1]The Climate Change Act 2008 introduced into law a national target of carbon emission reduction of 80 % below a 1990 baseline by 2050. Limited to Scope 1 and 2 emissions, it was the first piece of legislation of its kind in the world.

annual mechanism, there are 94 mandatory categories that cover all aspects of the campus estate's activities and an entire record of more than 600.

A review of literature highlights an absence of transparent, repeatable, full-scale higher education institution (HEI) carbon footprints that use robust data and avoid particularized assumptions. Although there is research being conducted to address this, the examples of full scope carbon footprints are few [e.g. Norwegian University of Science and Technology (Larsen et al. 2013), De Montfort University (Ozawa-Meida et al. 2011), University of Cape Town (Letete and Marquard 2011)]. The body of literature regarding the management of carbon emissions at universities is growing. In addition, the value and potential for carbon management as a future strategy scenario is increasingly being recognised at a time where university vice chancellors are under severe funding pressures (Klein-Banai and Theis 2013). HEIs are places of work, study and recreation that undertake a broad range of activities in order to fulfil research and teaching commitments and provide the required amenities and support services (Zhang et al. 2011). Between institutions, these activities differ considerably and undoubtedly vary across the institution too, i.e. activities undertaken in one location on the estate are more often than not, significantly different to the activities undertaken in another. Factors such as the academic specialism of the institution, the number of students and the physical location/layout of the campus are some of the attributes that account for the vast array and variety of activities that are performed (Larsen et al. 2013; Klein-Banai and Theis 2013). Understanding all of these activities is a complex task, but the results can afford environmental practitioners the ability to target emission reduction strategies on highly emitting activities (Disterheft et al. 2012).

In practice, limited resources mean that the managers responsible for reporting the environmental information of a HEI are unable to fulfil the requirements of standardised carbon compliance frameworks and international carbon footprinting standards. This has led to a situation where universities may be extolling their environmental credentials whilst being unable to fully acknowledge and manage the carbon emissions for which they are responsible. In being compliant with these calculation/reporting standards, HEIs (and organisations along the supply chain) are exposed to emission double counting. Their design encompasses both upstream and downstream activities, which, when aggregated at the sector level presents an artificially inflated figure. Couple this with low confidence data and a number of factors combine to significantly undermine the value of HEI emission reports. Thus, this paper, through critical review, introduces the shortcomings of current methodologies to the reader and seeks to identify a new and rational approach to avoid double counting.

In terms of scope, we focus here on institutions comprising the United Kingdom HE sector and acknowledge that universities around the world do vary. Additionally, the paper is constrained by considering only the environmental impact of activities through the release of greenhouse gas emissions but it should be noted, universities are making tangible efforts to reduce their impact on a plethora of other environmental, social and economic sustainability indicators i.e. pollution mitigation, promoting good health and wellbeing and education.

2 Carbon Footprinting Methods

Carbon footprinting is a key tool for environmental practitioners across all disciplines and at all scales, in understanding the environmental impact of their actions. Methods are becoming more widely available and increasingly used, for instance, on the internet by individuals (Birnik 2013), by organisations developing low-carbon supply-chains (Davis et al. 2011) and by governments for informing their policy decisions (Huang et al. 2009). A plethora of methods and models have been developed in recent years that assist in the calculation of emissions for a wide variety of settings and scales (see Fig. 1). Three major approaches can be taken based on the degree of accuracy required, the volume of data that is accessible and the scale to which the footprint is applied. Process analysis (PA) is a bottom-up method commonly used for interrogating the micro scale, whilst environmentally extended[2] input-output analysis (EEIOA) is commonly used for macro-scale applications (Peters 2010).

PA (through life-cycle assessment) is primarily suited to understanding the cradle-to-grave emissions of singular products (using inputs such as materials and energy use) where analysing each single step in producing a product is appropriate (Recker et al. 2011). This allows practitioners to understand the emissions of the various life stages of individual products, enabling management and reduction through the supply chain. For larger systems, PA was deemed too time-consuming and onerous, so EEIOA was developed to glean information on a macro-economic level (Munksgaard et al. 2008; Minx et al. 2009). Here, the environmental burden of all supply chain, production and consumption processes are determined for an entire economic system with Blue Book[3] financial data and financial transaction matrices (Larsen et al. 2013). The drawback of large-scale models is that all the data is aggregated due to the volume involved and so there is a lack of resolution down to the individual product level (Munksgaard et al. 2008).

Hybrid models are commonly used for mesoscale applications such as cities and large organisations, to improve upon the lack of resolution present in EEIOA and avoid dwelling for too long with the minutiae, as through the application of PA (Larsen et al. 2013). The word 'hybrid' is used to describe two situations: the use of physical, measured data alongside monetary values and the integration of sector-level and industry-level information. These models allow process-level user input to be coupled with large system boundary characteristics from the EEIOA (Suh et al. 2004; Sharrard et al. 2008). Additionally, hybrid models are less time-consuming than PA models although the level of detail is also less than that of PA (Baboulet and Lenzen 2010).

[2]'Environmentally extended' refers to the assigning of GHGs to the financial transactions normally modelled in economic input-output analysis (IOA) (first introduced by Wassily Leontief in the 1930s).

[3]The Blue Book is a key annual publication of UK National Accounts statistics and an essential data source for anyone concerned with macro-economic policies and studies.

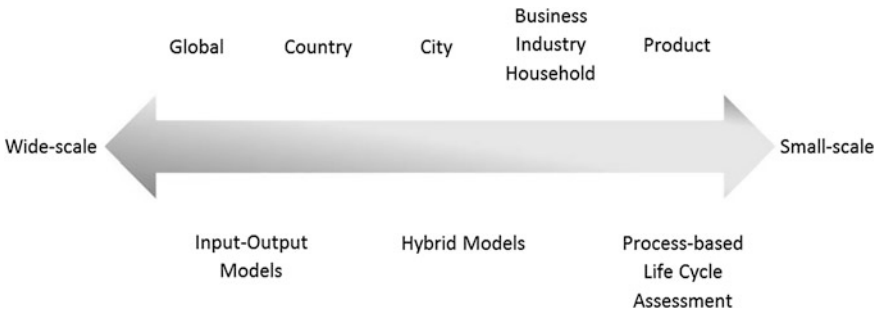


Fig. 1 Carbon footprinting at multiple scales, adapted from Peters (2010)

3 Carbon Footprinting of Organisations

Hybrid EEIOA is the method most favoured by the well-known international standard setting organisations i.e. the International Standardisation Organisation (ISO), the UK Department of Environment, Food and Rural Affairs (Defra) and the World Resources Institute. Initially, all of these methodologies require the practitioner to set the organisational and operational boundaries and in doing so, take responsibility of the entities and activities it influences, for inclusion in the assessment (Dragomir 2012; Gao et al. 2013). The formal setting of the boundary can take either 'equity share' or 'control' approaches. The equity share approach allows an organisation to account for emissions of an entity according to the percentage ownership of the operation; consequently, the percentage ownership of the activity determines the percentage responsibility the reporting organisation has over its emissions (Dragomir 2012). The control approach (subsequently divided into a financial or operational control) assigns emissions according to the form of control that the reporting organisation has over the operation (Pelletier et al. 2013).

The operational boundary is concerned with the individual activities for which the organisation is responsible at each of the physical sites included. Assigning emissions here has long been a contentious issue (Bastianoni et al. 2004) and as to avoid common mistakes, scopes were developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) in the 2004 'GHG Protocol'. Primarily, the emissions arising from within the boundary of the organisation are the easiest to assign and calculate (Williams et al. 2012), but as can be seen in Fig. 2, emissions also arise upstream (indirect emissions from purchased/acquired goods and services) and downstream (indirect emissions from sold/distributed goods and services) of the supply chain.

By far the greatest factor in making reliable conclusions from a carbon footprint is based on the quality of activity data (Von Bahr et al. 2003; Rypdal and Winiwarter 2001). Completeness, consistency, transparency and accuracy are listed by Amani and Schiefer (2011) as the most importance characteristics of quality

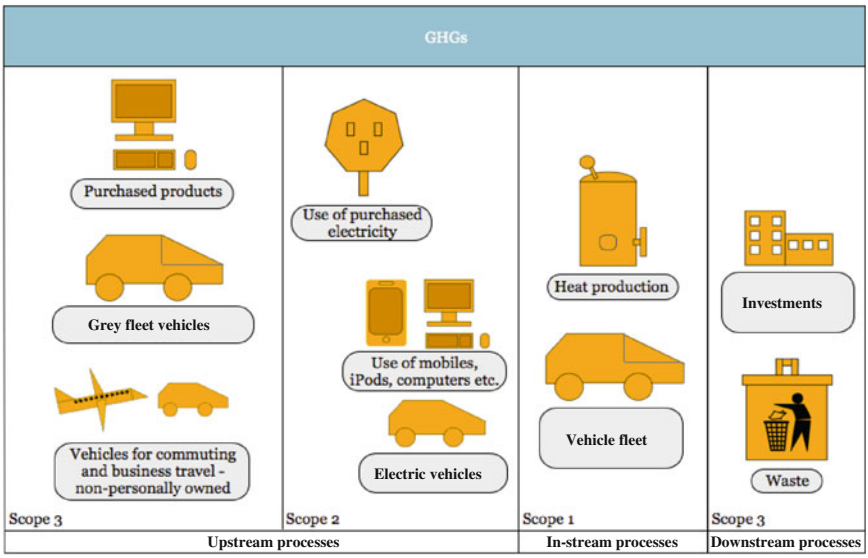


Fig. 2 The emission scopes included in a corporate footprint, adapted from Bhatia et al. (2011)

data. The detail that is needed by the practitioner is a function of the selected data 'tier' and the aim of the footprint. Direct emissions are the simplest to quantify for reasons relating to the simplicity of the calculation and the accessibility of the data. For instance, total scope 1 emissions are calculated by applying directly metered energy use data (for stationary combustion, which refers to the consumption of gas in onsite boilers) or fuel (spend or quantity, for mobile combustion) to an emission factor and reporting the result. The complexity lies in obtaining the data for the plethora of scope 3 activities where multiple data sources are needed. For instance, in understanding the embedded emissions of purchased products, information on each step of the manufacturing process along the supply chain needs to be gathered (Song and Lee 2010).

4 The University Context

The nature of delivering HE means that environmental impacts arise predominantly as a result of the consumption of electricity, purchased products and business travel (Ozawa-Meida et al. 2011). The use of diverse infrastructure plays a key role in the delivery of research and teaching programmes, combining activities such as delivering lectures, providing library facilities and ICT equipment with the attendance of academic conferences, the delivery of field courses and the running of sports teams etc. Responsible for considerable populations, comparisons are often made with small towns in the way infrastructure is arranged and delivered; the

resulting complexity makes the task of quantifying GHG emissions for all activities a significant challenge.

Two perspectives, production or consumption, offer a way to avoid complications associated with double counting at the sector level and the complex calculations required to produce reports (which are all-too-often based on unreliable data) (Bastianoni et al. 2004; Wiedmann and Minx 2008; Davis and Caldeira 2010). Production-based assessments only consider activities which generate GHGs within the organisational boundary, whilst consumption-based assessments allocate emissions originating outside of the organisational boundary (embodied in goods and services for use within it) (Hoornweg et al. 2011). The virtues of both of these methods have been greatly studied in detail, and generally in recent years, there has been a move from reporting a production-based footprint (following the guidelines set by the Intergovernmental Panel on Climate Change) to a more consumption-based approach (Larsen and Hertwich 2009; Ozawa-Meida et al. 2011). Although both numbers may be different when finally calculated, both are indeed a true representation of GHG emissions attributed to the institution, albeit from different perspectives.

There is often a moral choice when assigning and accounting emissions and both methods exhibit relative advantages and disadvantages. For instance, taking a consumption perspective means to absolve the producer of any responsibility, whilst in taking a production perspective, one does not account for the role that consumers have in creating the demand for products and services. By understanding where resources are consumed, the tendency to burden-shift emissions geographically is avoided, however the key considerations surrounding double counting still exist. In the context of a university, far more activities which one may class as ‘consumption-based activities’ are undertaken than ‘production-based activities’ (see Fig. 2 for demarcation). By favouring the production footprint however, the process that time-poor environmental practitioners must go through is significantly streamlined. Furthermore, the environmental responsibility for products and services shifts back up the supply chain to the supplier organisations that so far have remained anonymous and apparently ‘low-carbon’ or ‘carbon-neutral’. Fundamentally, in order for comparisons between institutions to be fair, uniformity during the reporting phase is key. By ensuring this, double-counting is avoided altogether when either a production or a consumption perspective is used.

Understanding consumption behaviours is still imperative in implementing strategic emission reduction policies across the HEI estate. Therefore a compromise which reconciles the need for good internal knowledge with genuine uniform reported values is called for. We can propose that HEIs should centrally report production-based GHG emissions, used for sector aggregation and performance-tracking. In addition, HEI should strive to develop consumption-based GHG emission figures for internal management purposes and for the implementation of carbon reduction measures. The established calculation and reporting procedures for activities influencing Scope 1 and 2 emissions should remain unchanged.

In reality, further work is needed to ensure that consumption-based GHG assessments for internal use are comprised of reliable and replicable data. Often, practitioners are under pressure to lead in all areas relating to environmental sustainability across the estate, so are therefore pressed for resources directed at carbon management. Since our proposal removes any timeline or limit for reporting consumption values, HEIs are bought some time to initiate the required data collection procedures. Currently, methods for collecting carbon data are deemed to be underdeveloped (Riddell et al. 2009) and focus primarily on quantifying direct emissions (Higher Education Funding Council for England 2010a) so any improvements are likely to be very valuable. Reducing sources of error and uncertainty in university carbon footprints is a particular current focus for researchers in recent years. Ultimately, the decision upon which approach is taken rests on the environmental practitioner and the intended use of the footprint.

5 Sustainability Opportunities

Many institutions tackle carbon reduction through varied and all-encompassing sustainability initiatives (Atherton and Giurco 2011). 'Hard' instrumental measures include marketization (financial/market instruments), as well as regulatory and legislative approaches (Jerneck et al. 2011) whilst 'soft' democratic measures primarily focus on education. Incorporating sustainability into the operating procedures of universities promises to yield a number of significant benefits. The importance of removing the barriers to change in order to shift the lifestyle paradigm of the population is seen as invaluable to the movement (Minx et al. 2009). Reducing emissions in universities is complex and time-consuming for a number of reasons; the transient nature of staff and students, the typically numerous building stock spread amongst a number of campuses and aging infrastructure means that environment teams often have to be innovative with their approach.

By fully engaging with carbon management, institutions are able to adapt to the encroaching issues faced as a result of climate change. Carbon footprinting in particular enables better management through understanding the scale of the problem that is to be tackled (Robinson et al. 2015). By acknowledging that a shifting climate will force the need for institutions to switch to sustainable practices is necessary to their survival. Through effective carbon management planning, institutions can hope to successfully engage students, whilst maintaining the educational missions of the institution. These schemes can be in keeping with the cultural identity of the institution, whilst behaviour change fosters a longer lasting switch to low-carbon practices.

Increasingly, environmental sustainability through carbon management is a tangible method of achieving league table progress and national/international recognition through awards and industry recognition. This is deemed important due to the difficult recruitment environment and the rising trend of students factoring environmental sustainability into their decision making process when choosing

which institutions to study at. Despite all the challenges that are associated, significant financial benefits have been documented that institutions can expect to receive. Not only is this applicable inwardly, but also outwardly in wider society through a leaner economy where emissions are decoupled from growth (Stephens et al. 2008). Despite the need for capital investment to yield results, healthy returns can be made when implementing well-planned carbon reduction schemes.

6 Conclusions

Organisations have tended to opt for hybrid models to capture the carbon emissions for which they are responsible because activities are performed upstream and downstream of the organisational boundary. This approach inherently promotes double counting when being reported. A consumption-based carbon footprint enables organisations to evaluate the full extent of their environmental impacts, thereby empowering them to make strategic actions to reduce them. However, the use of this method relies on the use of data often held externally or not collected. A production based carbon footprint does away with the latter issue, but uniformity should be fostered because reporting different perspectives will inevitably lead to double counting.

In order to avoid these issues, we recommend that two figures ought to be reported by higher education institutions. A production-based carbon footprint figure should be reported by all to detail the emissions solely originating from, and fully attributable to, the institution. This method is the most straightforward and could always be reported as a "minimum standard". Adding together production-based emissions would give an idea of the total carbon emissions from the sector without fear of double-counting. In addition, a consumption-based figure could be reported that details the emissions attributable to *every* activity the reporting institution undertakes. This approach is more resource-intensive and time-consuming and would be used internally by those interested in fully capturing the carbon footprints associated with their full range of activities in terms of informing their carbon reduction strategies.

This research signifies the starting point for the development of a standardised methodology for assessing the climate impacts of HEIs, which is appropriate to their contextual setting. This will not only be relevant to the international HE sector, but parallels may be drawn to assist all organisations in quantitatively assessing the impact of their activities through the development of a universal framework. Further work must now be conducted to build the details of the methodology, considering the time and financial cost of each step in order to minimise these as pressures experienced by environmental practitioners daily. Additionally, further decisions about the resolution needed to effectively inform carbon management policies will also be explored and determined.

References

Amani, P., & Schiefer, G. (2011). Data availability for carbon calculators in measuring GHG emissions produced by the food sector. *International Journal on Food System Dynamics, 2*(4), 392–407.

Atherton, A., & Giurco, D. (2011). Campus sustainability: Climate change, transport and paper reduction. *International Journal of Sustainability in Higher Education, 12*(3), 269–279.

Baboulet, O., & Lenzen, M. (2010). Evaluating the environmental performance of a university. *Journal of Cleaner Production, 18*(12), 1134–1141.

Von Bahr, B., Hanssen, O. J., Vold, M., Pott, G., Stoltenberg-Hansson, E., & Steen, B. (2003). Experiences of environmental performance evaluation in the cement industry. Data quality of environmental performance indicators as a limiting factor for benchmarking and rating. *Journal of Cleaner Production, 11*(7), 713–725.

Bastianoni, S., Pulselli, F. M., & Tiezzi, E. (2004). The problem of assigning responsibility for greenhouse gas emissions. *Ecological Economics, 49*(3), 253–257.

Bhatia, P., Cummis, C., Brown, A., Rich, D., Draucker, L., & Lahd, H. (2011). *Greenhouse gas protocol. Corporate value chain (scope 3) accounting and reporting standard*. World Resources Institute and World Business Counci for Sustainable Development: Geneva, Switzerland.

Birnik, A. (2013). An evidence-based assessment of online carbon calculators. *International Journal of Greenhouse Gas Control, 17*, 280–293.

Cummis, C., Draucker, L., Khan, S., Ranganathan, J., & Sotos, M. (2013). *Technical guidance for calculating scope 3 emissions*. World Resources Institute and World Business Counci for Sustainable Development: Geneva, Switzerland.

Davis, S. J., & Caldeira, K. (2010). Consumption-based accounting of CO_2 emissions. *Proceedings of the National Academy of Sciences of the United States of America, 107*(12), 5687–5692.

Davis, S. J., Peters, G. P., & Caldeira, K. (2011). The supply chain of CO_2 emissions. *Proceedings of the National Academy of Sciences of the United States of America, 108*(45), 18554–18559.

Disterheft, A., da Silva, Ferreira, Caeiro, S. S., Ramos, M. R., & de Miranda Azeiteiro, U. M. (2012). Environmental management systems (EMS) implementation processes and practices in European higher education institutions—Top-down versus participatory approaches. *Journal of Cleaner Production, 31*, 80–90.

Dragomir, V. D. (2012). The disclosure of industrial greenhouse gas emissions: A critical assessment of corporate sustainability reports. *Journal of Cleaner Production, 29–30*, 222–237.

Flint, K. (2001). Institutional ecological footprint analysis—A case study of the University of Newcastle, Australia. *International Journal of Sustainability in Higher Education, 2*(1), 48–62.

Gao, T., Liu, Q., & Wang, J. (2013). A comparative study of carbon footprint and assessment standards. *International Journal of Low-Carbon Technologies, 9*(3), 237–243.

Higher Education Funding Council for England. (2010a). *Carbon management strategies and plans: A guide to good practice*. HEFCE: Bristol.

Higher Education Funding Council for England. (2010b). *Carbon reduction target and strategy for higher education in England*. HEFCE: Bristol.

Hoornweg, D., Sugar, L., & Trejos Gomez, C. L. (2011). Cities and greenhouse gas emissions: moving forward. *Environment and Urbanization, 23*(1), 207–227.

Huang, Y. A., Lenzen, M., Weber, C. L., Murray, J., & Matthews, H. S. (2009). The Role of input–output analysis for the screening of corporate carbon footprints. *Economic Systems Research, 21*(3), 217–242.

Jerneck, A., Olsson, L., Ness, B., Anderberg, S., Baier, M., Clark, E., et al. (2011). Structuring sustainability science. *Sustainability Science, 6*(1), 69–82.

Klein-Banai, C., & Theis, T. L. (2013). Quantitative analysis of factors affecting greenhouse gas emissions at institutions of higher education. *Journal of Cleaner Production, 48*, 29–38.

Larsen, H. N., & Hertwich, E. G. (2009). The case for consumption-based accounting of greenhouse gas emissions to promote local climate action. *Environmental Science & Policy, 12* (7), 791–798.

Larsen, H. N., Pettersen, J., Solli, C., & Hertwich, E. G. (2013). Investigating the carbon footprint of a university—The case of NTNU. *Journal of Cleaner Production, 48*, 39–47.

Letete, T. C. M., & Marquard, A. (2011). Carbon footprint of the University of Cape Town. *Journal of Energy in Southern Africa, 22*(2), 2–12.

Matthews, H. S., Hendrickson, C. T., & Weber, C. L. (2008). The importance of carbon footprint estimation boundaries. *Environmental Science and Technology, 42*(16), 5839–5842.

Minx, J. C., Wiedmann, T., Wood, R., Peters, G. P., Lenzen, M., Owen, A., Scott, K., et al. (2009). Input–Output analysis and carbon footprinting: An overview of applications. *Economic Systems Research*, *21*(3), 187–216.

Munksgaard, J., Wier, M., Lenzen, M., & Dey, C. (2008). Using input-output analysis to measure the environmental pressure of consumption at different spatial levels. *Journal of Industrial Ecology, 9*(1–2), 169–185.

Ozawa-Meida, L., Brockway, P., Letten, K., Davies, J., & Fleming, P. (2011). Measuring carbon performance in a UK University through a consumption-based carbon footprint: De Montfort University case study. *Journal of Cleaner Production, 56*, 185–198.

Pelletier, N., Allacker, K., Pant, R., & Manfredi, S. (2013). The European commission organisation environmental footprint method: Comparison with other methods, and rationales for key requirements. *The International Journal of Life Cycle Assessment, 19*(2), 387–404.

Peters, G. P. (2010). Carbon footprints and embodied carbon at multiple scales. *Current Opinion in Environmental Sustainability, 2*(4), 245–250.

Pike, G. (2012). From internationalism to internationalisation: The illusion of a global community in higher education 1 global education and international education: Responses to globalisation. *Journal of Social Science Education, 11*(3), 133–149.

Recker, J., Rosemann, M., & Gohar, E. (2011). Measuring the carbon footprint of business processes. *Business Process Management Workshops*, 511–520.

Riddell, W., Bhatia, K. K., Parisi, M., Foote, J., & Iii, J. I. (2009). Assessing carbon dioxide emissions from energy use at a university. *International Journal of Sustainability in Higher Education, 10*(3), 266–278.

Robinson, O., Kemp, S., & Williams, I. (2015). Carbon management at universities: A reality check. *Journal of Cleaner Production, 106*, 109–118.

Rypdal, K., & Winiwarter, W. (2001). Uncertainties in greenhouse gas emission inventories–evaluation, comparability and implications. *Environmental Science & Policy, 4*(2–3), 107–116.

Schofer, E., & Meyer, J. W. (2005). The worldwide expansion of higher education in the twentieth century. *American Sociological Review, 70*(6), 898–920.

Sharrard, A. L., Matthews, H. S., Asce, A. M., & Ries, R. J. (2008). Estimating construction project environmental effects using an input-output-based hybrid life-cycle assessment model. *Journal of Infrastructure Systems, 14*, 327–336.

Song, J.-S., & Lee, K.-M. (2010). Development of a low-carbon product design system based on embedded GHG emissions. *Resources, Conservation and Recycling, 54*(9), 547–556.

Stephens, J. C., Hernandez, M. E., Román, M., Graham, A. C., Scholz, R. W., Stephens, J. C., et al. (2008). Higher education as a change agent for sustainability in different cultures and contexts. *International Journal of Sustainability in Higher Education, 9*(3), 317–338.

Suh, S., Lenzen, M., Treloar, G. J., Huppes, G., Jolliet, O., Klann, U., et al. (2004). Critical review system boundary selection in life-cycle inventories using hybrid approaches. *Environmental Science and Technology, 38*(3), 657–664.

Wiedmann, T., & Minx, J. C. (2008). A definition of a "carbon footprint." In *Ecological Economics Research Trends* (pp. 1–11). Hauppage, New York: USA: Nova Science Publishers.

Williams, I., Kemp, S., Coello, J., Turner, D. A., & Wright, L. A. (2012). A beginner's guide to carbon footprinting. *Carbon Management, 3*(1), 55–67.
Zhang, N., Williams, I. D., Kemp, S., & Smith, N. F. (2011). Greening academia: Developing sustainable waste management at higher education institutions. *Waste Management, 31*(7), 1606–1616.

Author Biographies

Oliver Robinson is a Doctorate of Engineering researcher, working in the Carbon Management Group at the University of Southampton's Centre for Environmental Science. He graduate from the same university with a Master's degree in Environmental Science and is conducting his doctoral research which focusses on quantifying the emissions of activities undertaken by universities.

Professor Simon Kemp is the Professorial Fellow in Education for Sustainable Development at the University of Southampton. He specialises in Education for Sustainable Development, Environmental Management Systems, Carbon Footprinting, Environmental Law and Waste Management.

Professor Ian Williams is the head of the Centre for Environmental Science at the University of Southampton. Ian obtained his first degree in Chemistry from the University of Surrey in 1988 and a Ph.D. from Middlesex University in 1995. He specialises in environmental pollution and resource management.